JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOLUME 39 APRIL 15, 1949 No. 4

MEDICINE.—*Morbidity from cancer.*[1] HAROLD F. DORN, National Cancer Institute. (Communicated by FREDERICK D. ROSSINI.)

Approximately 3,500,000 children were born in the United States during the calendar year 1948. If existing morbidity rates from cancer and mortality rates from all causes of death except cancer should remain unchanged, 700,000, or one-fifth of these children, will develop cancer during their lifetime. To state this fact in another way, the probability that a newborn child will develop cancer during his lifetime is one out of five.

The chances at birth of developing cancer are about 17 percent greater for females than for males; the chances are 228 per 1,000 for females compared with 195 per 1,000 for males. This difference becomes smaller with increasing age, so that by age 50 the chance of developing cancer is approximately equal for each sex. After that age, although the chances of developing cancer decrease for each sex, they decrease more rapidly for women than for men with the result that the male rate is 40 percent higher than the female rate by age 80.

It is estimated that at least one-third of a million new cases of cancer are diagnosed annually in the United States. In addition, an equal number of cases, previously diagnosed, are still under observation or treatment, so that all together around two-thirds of a million persons with cancer receive medical care at some time during each year.

Is the number of persons who develop cancer larger now than formerly? Reliable morbidity statistics of cancer have been available only within the past ten years, and so the answer to this question must be partly estimated. The National Cancer Institute at the present time has under way a study to determine changes in morbidity from cancer during the past decade. As soon as the results of this study are available a more definite answer can be given to this question.

In spite of the lack of accurate morbidity statistics, it is almost certain that the number of persons in the United States today with cancer is larger than the number twenty years ago. The total population now is 27,000,000 greater than twenty years ago. In addition, the proportion of the population in the older age groups has been increasing steadily. Since the probability of developing cancer increases rapidly with increasing age, the aging of the population will result in a larger number of cases of cancer, even though the morbidity rate per 1,000 persons at each age remains unchanged.

It is easy to overlook the effects of the remarkable increase in the average length of life that has taken place since the beginning of the present century. Under the mortality conditions existing in 1900, one-half of the births in that year would live to age 58. Under the mortality conditions existing in 1940, one-half of the births of that year would live to age 70.

This increase in the proportion of the persons who live to advanced ages has resulted in an increase in the number of persons with cancer and other diseases of late adult life. With the mortality rates prevailing in 1900, about 5 percent, or one out of every twenty newborn children, would be expected to die from cancer. By 1940 about 12 percent, or one out of every eight newborn children, would be expected to die from cancer. Thus the probability of eventually dying from cancer has more than doubled since 1900. But this increase is due to a decrease in the death rate from causes other than cancer

[1] Received January 31, 1949.

as well as to some increase in the death rate from cancer.

In addition to the increase in the number of cases of cancer resulting from the increase in the size of the population and from the fact that more people now live to the ages when cancer is most frequent, has there been any increase in the number of cases of cancer which can be attributed to changes in environmental or other factors? A definite answer can not be given to this question. Although very little is known today about specific causes of cancer in human beings, most of the causes that have been identified are environmental in character. This does not mean that genetic factors may not be important, but their precise role in human cancer is not known at the present time. There is considerable evidence that many chemicals and other materials used in industry are capable of causing cancer. Quantitative evidence is not available, but it is believed by some that the number of persons with occupationally induced cancer has increased in recent years.

One of the striking features of cancer is that it is found most frequently among elderly people. This should not blind us to the fact that cancer occurs at every age. Among males cancer does not occur very frequently until age 40. After this age, morbidity rates increase so rapidly that by age 75 they are about 14 times higher than the rates at 40 years of age. Morbidity from cancer becomes important at an earlier age among females than among males. Cancer is about as frequent among females at 30 years of age as it is among males of 40 years of age.

Nearly three-fourths of all cancer in females and one-half of all cancer in males develop in either the digestive or genital systems. Among females the breast and genital organs are attacked most frequently. Out of every 100 women who develop cancer 50 will have cancer of the genital system or breast and 25 will have cancer of the digestive system. Among males in about 40 out of every 100 who develop cancer the growth originates in the digestive system. The respiratory and urinary systems are relatively infrequent sites of cancer in both males and females.

The higher incidence of cancer among females is due entirely to the greater susceptibility of the female genital system to cancer. If we exclude cancer of the genital system, the incidence rate of cancer in males is about 60 percent higher than the rate for females.

Why should the female genital system be attacked by cancer so much more frequently than the male genital system? There are many theories, but little objective evidence bearing on this question. It is thought by some that cancer of the cervix may result from lacerations and tears during childbirth. However the importance of this factor is not known: There is some statistical evidence that cancer of the genital organs is more frequent among married women than among single women. On the other hand, cancer of the breast is more frequent among single than among married women. Married women who have borne children have a lower death rate from cancer than married women who have not borne children. The mere performance of a marriage ceremony almost certainly has nothing to do with the development of cancer. Physiological changes associated with childbearing or lack of childbearing undoubtedly are related to the greater frequency of cancer of the uterus in married women and of cancer of the breast in single women. The relationship between such changes and the development of cancer is not understood at the present time.

The only other important sites where cancer develops as frequently in women as in men are the brain, thyroid, liver, and intestines. The brain, thyroid, and liver are relatively infrequent sites of occurrence of cancer. The intestines, however, are a fairly common site of origin.

It was once thought that Negroes were relatively immune from cancer. This belief probably arose from the failure of cancer to be diagnosed among Negroes. The incidence rate among females is about 10 percent higher for whites than for Negroes; among males the rate for Negroes is only about one half that for whites. There seems to be no good reason to account for the relatively low morbidity rate among Negro males except failure to receive medical care.

There is one racial difference in susceptibility to cancer that tends to cause a higher cancer illness rate among whites than among Negroes. Dermatologists and clinicians long have believed that light-skinned persons are more likely to develop cancer of the skin than are persons with more pigmentation. The morbidity rates for cancer of the skin of whites and Negroes support this belief. The incidence rate for cancer of the skin is about seven times greater among whites than among Negroes.

In contrast to the definitely lower susceptibility of Negroes to cancer of the skin is the greater susceptibility to cancer of the genital organs especially among females. Even though the incidence rate for all forms of cancer is only about one-half as great for Negro as for white males, the rate for cancer of the genital organs is approximately the same. Cancer of the uterus is 60 percent more frequent among Negro than among white women. The situation is reversed for cancer of the genital organs other than uterus. The prevalence rate for cancer of the breast is 50 percent higher and that for other sites such as vagina, vulva, and ovaries is 85 percent higher for white females.

It has been suggested that the high incidence of cancer of the genital organs in Negro males and of cancer of the uterus in Negro females may be related to venereal disease. Syphilis and other venereal diseases are known to be much more frequent among Negroes. It has not been clearly established, however, that the existence of syphilis increases susceptibility to cancer, so that, at the present time, the high incidence of cancer of certain of the genital organs among Negroes can not be satisfactorily explained.

Cancer attacks proportionately more people living in the South than in any other region of the United States. The number of new cases per 100,000 population per year is nearly 50 percent higher for the white population in the South than in the North. This is in striking contrast to the general belief that cancer is less common in the South. This belief arises from the fact that mortality rates actually are lowest in the South and highest in the Northeast and Pacific Coast States.

The high illness rate from cancer in the South is due primarily to the relatively larger number of cases of skin cancer in that region. Since skin cancer can be readily cured, mortality rates from cancer in the South are lower than in the North, even though the illness rate for all forms of cancer is higher.

Skin cancer is nearly five times as frequent in the white population in the South as in the North and about two and one-half times as frequent as in the West. Although Negroes are less susceptible to skin cancer than whites, the illness rate from skin cancer is twice as high among Negroes living in the South as among Negroes in the North.

There is considerable circumstantial evidence that the high incidence of skin cancer in the South is related to exposure to sunlight. In addition, clinical observations have shown that cancer of the skin occurs principally on exposed areas of the body and that it is more frequent among outdoor workers such as farmers and seamen. Laboratory experiments also have demonstrated that mercury arc radiation and natural sunlight will cause cancer in rats and mice. Although the mechanism of tumor production by radiation is not clearly understood, the available evidence of the relationship between sunlight and skin cancer points strongly to a causal connection between the two.

GEOLOGY.—*A newly discovered type of clay deposit in Utah.*[1] CHARLES B. HUNT, U. S. Geological Survey, A. S. CREAMER, National Bureau of Standards, and JOSEPH J. FAHEY, U. S. Geological Survey.

A type of clay deposit, recently discovered as a result of systematic regional geological surveys in Utah, may prove to be a valuable source of raw material for brick and structural clay products. The deposits were first discovered in Utah Valley, where the U. S. Geological Survey has been conducting a regional survey and study. Subsequent reconnaissance proves that the deposits are widely distributed in Utah and extend into adjoining states. In a cooperative study, tests of samples of the clay by the National Bureau of Standards indicate that the clay has certain qualities that are generally lacking in most of the clays in the region.

The deposits that have been the principal sources for clay in Utah are chiefly of two kinds: beds of clay interstratified with the fill in the valleys in western Utah and shale formations in the older rocks that occur in or near the mountains and plateaus. The newly discovered source is a clay that formed as an ancient soil.

Field occurrence.—The ancient soil that may prove to be a valuable source of clay was formed during those glacial or interglacial periods that preceded the existence of Lake Bonneville. This is a critical fact in prospecting for commercial deposits because the clay obviously will be found only at those places where the land surface has been preserved since pre-Bonneville time without being either eroded or buried by other sediments.

The ancient soil, where preserved in its entirety, is deep. The clay occurs in the upper part of the soil and in places is 10 feet thick. Beneath the clay are 20 or 30 feet of strongly lime-enriched, weathered parent material; the top of this lime-rich zone would form the bottom of pits that might be opened in the clay.

The clay comprising the upper layer of the old soil is practically free of lime but does contain considerable iron oxide. The most common clay mineral is of the hydromica type and there is a minor quantity of montmorillonite; much more study of the mineralogy of the deposits is needed before it will be possible to generalize about the mineral or chemical composition of the deposits.

The texture of the clay, or its content of sand aggregate, varies considerably depending on the parent rock from which the old soil was formed. The soil is known to have formed from limestone, shale, granitic rocks, lavas, and mixtures of these. The parent rocks, except for their quartz or other resistant minerals, were completely altered to clay by the soil-forming process. Where, for example, the soil developed on a shale formation, very little sand aggregate remains and more than 90 percent of the clay can be washed through a 325-mesh sieve. On the other hand, where the soil developed on gravel or other deposits containing much quartz, this material remains with the clay. Sixty to seventy percent of this kind of clayey material can be washed through a 325-mesh sieve.

Because the deposits are remnants of a land surface that has been modified by erosion since the deposits were formed, their size and shape vary widely. The thickest and most extensive deposits occur on smoothly rounded upland surfaces (Fig. 1) where several feet of clay may extend over a number of acres. Some individual deposits already known contain many tens of thousands of cubic yards of clay. Undoubtedly there are many more deposits, some of which probably are larger than the few observed thus far. Although the individual deposits are not large, the total reserves available are believed to be immense.

Chemical and optical properties.—The essential constituents, other than the alkalies, of the three samples that have been studied, are listed in Table 1. The high content of iron oxide made index measurements of the clay minerals impossible. A thermal analysis by George T. Faust and an X-ray powder examination by Joseph M. Axelrod,

[1] Published by permission of the Director, U. S. Geological Survey. Received February 1, 1949.

TABLE 1.—PARTIAL CHEMICAL ANALYSES OF SAMPLES OF CLAYS FROM SOME ANCIENT SOILS IN UTAH (J. J. FAHEY, ANALYST)

	Sample 1	Sample 2	Sample 3
	Percent	*Percent*	*Percent*
Loss on ignition	6.78	6.88	6.83
SiO_2	67.37	69.61	66.07
Al_2O_3	13.86	12.65	15.54
Fe_2O_3	5.10	4.58	6.02
MgO	1.67	1.51	1.87
CaO	0.02	0.02	0.02
TiO_2	0.75	0.70	0.96
MnO	0.003	0.003	0.003

Sample 1, old soil on oldest of glacial moraines by Dry Creek, above Alpine. Sample 2, old soil on fanglomerate from near reservoir in Traverse Range ± 2 miles northwest of Alpine. Sample 3, old soil formed on Manning Canyon shale, south side of Provo Canyon, by Pole Canyon road ± 2 miles from Provo Canyon Road.

both of the U. S. Geological Survey, indicate that the clay is predominantly hydromica. A minor quantity of montmorillonite is present.

Examined under the petrographic microscope sample No. 1 was found to contain approximately 20 percent quartz and 20 percent orthoclase, sample No. 2 about 25 percent quartz and 20 percent orthoclase and sample No. 3 about 20 percent quartz and 15 percent orthoclase.

Ceramic properties.—The suitability of the clay in the ancient soil for ceramic uses was investigated at the National Bureau of Standards. Data were obtained on the physical properties of samples of the clay taken from the three deposits listed in Table 1. In determining the properties, tests were made of grain size, tempering water, drying and firing shrinkage, firing range, and color of fired specimens. The results are summarized in Table 2.

Despite the difference in source of the samples of these old soil clays, certain similarities were found in the quality of the raw clays as well as in the properties of fired specimens. This clay is characterized by large amounts of fine material (66 to 93 percent), while the remaining material is of a sandy nature. Approximately the same quantities of tempering water (26 to 29 percent) resulted in good workability of the three samples of clay. A relatively long heating range of about 980° to 1080°C., or cones 06 to 03, was accompanied by small changes in shrinkage, and by a variation of shades of red and brown colors of the specimens.

The results of the tests indicate that these clays should be satisfactory for the manufacture of building brick and structural clay products.

Some aids in prospecting for commercial deposits.—The mode of origin of these clay deposits furnishes the most useful clues for prospecting for commercial deposits. Smoothly rounded upland surfaces are the most favorable localities. Depending on the proportion of aggregate desired in the clay, prospecting would be guided by the kind of parent rock under these upland surfaces.

Prospecting would be inexpensive because the clay occurs at the surface with no more than a few inches of recent rubble or humus above the clay. Hand augers are adequate for determining the quality, extent, shape, and thickness of a deposit.

In general the lime-rich zone that lies beneath the clay and that would form the floor of a development pit is undulatory and slopes toward the present valleys. Rarely can a level floor be expected beneath the clay. The slope of the floor, however, generally

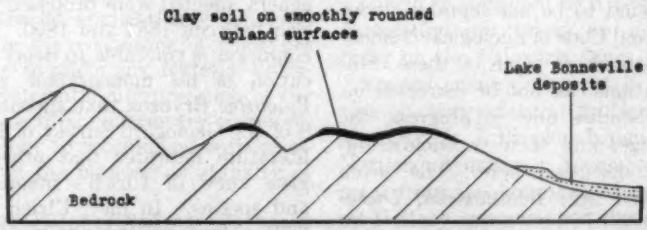

FIG. 1.—Diagrammatic section showing how ancient clay soil is preserved as erosion remnants on smoothly rounded upland surfaces in parts of Utah.

is much less steep than the present land surface so the deposits generally thicken in a direction away from the present valleys.

Listed below are a few of the most accessible localities in Utah where different kinds of deposits may be examined. These localities are cited merely so that persons interested in prospecting for this type of clay can acquaint themselves with some of the varieties that are available because of differences in the parent rocks; the particular deposits are not necessarily of commercial extent.

Clay containing considerable aggregate, in part pebbly, can be found in the eastern part of the Traverse Range immediately northwest of Alpine. This clay developed from gravel deposits containing pebbles of limestone, quartzite, granite, and latitic lavas. Similar high-aggregate-bearing clay that formed directly on bedrock formations of limestone, quartzite, and latitic lavas occurs in the western part of the Traverse Range.

Clay that contains very little aggregate, and that formed on a shale formation, is well exposed along the Pole Canyon Road on the south side of Provo Canyon.

Clay formed on a limestone formation is exposed in road cuts along U. S. Highway 91 between Brigham City and Wellsville. Clay formed on rhyolitic flows occurs in the Tintic district at the southwest base of Packard Peak about 1½ miles northwest of Eureka.

Many other localities are known; those listed are merely readily accessible examples of some of the varieties of the clay and they are not to be regarded as the most promising localities. Indeed, all the mountains in central and western Utah, the Uinta Mountains, and the high plateaus of central and south-central Utah are favorable areas for prospecting for these clay deposits. Similar areas in the adjoining parts of Colorado, Wyoming, Idaho, and Nevada appear to be equally promising.

TABLE 2.—CERAMIC TESTS OF SAMPLES OF CLAY FROM SOME ANCIENT SOILS IN UTAH

Clay sample No.	Sieve analysis				Tempering water	Shrinkage during drying	Total shrinkage after heating 1000°C./hr.	Color after heating 1000°C./hr.	Total shrinkage after heating 1100°C./hr.	Color after heating 1100°C./hr.
	On 100-mesh sieve	On 200-mesh sieve	On 325-mesh sieve	Through 325-mesh sieve						
	percent	*percent*	*percent*	*percent*	*percent*	*percent*	*percent*		*percent*	
1	19.2	8.2	6.5	66.1	29.2	8.4	13.3	Brown-red	7.5	Dark red brown
2	11.15	10.3	9.15	69.4	26.1	9.2	12.5	Brown-red	7.1	Dark red brown
3	3.9	1.0	2.2	92.9	29.4	—	10.2	Salmon	12.4	Dark red

PALEONTOLOGY.—*Genotypes of some Paleozoic Bryozoa.*[1] HELEN DUNCAN, U. S. Geological Survey. (Communicated by JAMES STEELE WILLIAMS.)

In the course of investigations of the literature on some Paleozoic Bryozoa, several species commonly considered to be genotypes were found to be inacceptable under the International Code of Zoological Nomenclature. Inasmuch as some of these erroneous designations can not be corrected incidentally in studies now in progress, the required changes and their taxonomic significance are discussed here. The seven genera involved are: *Batostomella*, *Dichotrypa*, *Meekopora*, *Nematopora*, *Taeniodictya*, *Trematella*, and *Worthenopora*.

With the exception of *Trematella* Hall, the genera affected were proposed by E. O. Ulrich between 1882 and 1890. Some of the confusion is traceable to delay in the publication of his monographic study of the Paleozoic Bryozoa that appeared in volume 8 of the Geological Survey of Illinois. The literature indicates that other paleontologists knew of Ulrich's manuscript genera and species. In fact, Ulrich (1890a: 679–680) voluntarily transmitted diagnoses of his unpublished genera, their intended geno-

[1] Published by permission of the Director, U. S. Geological Survey. Received February 17, 1949.

types, and lists of species included in each genus to S. A. Miller, who published all this information in his *North American geology and palaeontology*, which appeared in 1889, a year before the Geological Survey of Illinois volume. Most of the species Ulrich intended to make types of his new genera were *nomina nuda* in 1889 when Miller published the generic diagnoses. Fortunately, many of the lists in Miller consisted exclusively of undescribed species. Genotype designations for most of Ulrich's genera were therefore validated in 1890. However, the species lists for three genera—*Dichotrypa*, *Meekopora*, and *Worthenopora*—each contained a single previously described species. As the intended genotypes were *nomina nuda* and therefore unavailable in 1889, these three genera are monotypical, the one valid species listed for each in Miller's work being the type.

Conditions of original publication necessitate recognition of species other than those ordinarily cited as genotypes for *Batostomella*, *Nematopora*, and *Taeniodictya*. The fact that Ulrich first published these names prior to 1890 in connection with species he discussed or described restricts the selection of types to those species originally included in the genera.

According to Opinion 7 (On the interpretation of the expression "n.g., n.sp." under Article 30A), the genotype of *Trematella* Hall was fixed by a technicality of expression employed in the original publication. Consequently the species hitherto regarded as type of the genus is inadmissible.

Although these erroneous designations have been ignored or overlooked for more than half a century, their perpetuation, whether intentional or inadvertent, certainly should not be continued. Except in the case of *Batostomella*, application of Article 30 of the Code for the recognition of genotypes does not seem to make any material difference in the systematic interpretation of the genera. It would be unnecessary therefore, if not impossible, to recommend suspension of the Rules in the interests of stability of nomenclature.

The revised concept of *Batostomella*, based on the genotype selected by Miller, has rather extensive taxonomic implications. As now interpreted, the genus must be referred to another family of trepostomatous bryozoans and is therefore inacceptable zoologically as the type of a family characterized by structural features hitherto called "batostomellid." Owing to original misconceptions, a heterogeneous assemblage of genera had been assigned to the Batostomellidae, and the family stood in much need of revision even before present investigations demonstrated the name to be nomenclaturally inapplicable. On morphologic grounds, the taxonomic problem can be solved most practically by referring the early Paleozoic "batostomellid" genera to other families and by erecting a new family for the later Paleozoic "batostomellids." The family Stenoporidae is therefore defined to include the stenoporoid and leioclemoid types that formerly comprised the main elements of the Batostomellidae. The probable relationships of "batostomellid" genera that do not fall within the limits set for the new family are discussed so far as existing knowledge of them can be evaluated, and if possible these genera are assigned elsewhere in the classification.

In addition to the demonstrably erroneous designations here discussed, inconsistencies discovered in standard generic synonymies aroused doubt regarding the status of the genotypes commonly cited for *Lyropora*, *Ptylopora*, and *Streblotrypa*. As far as it has been possible to check, their type species appear to have been selected in accordance with Article 30 of the Code. However, the synonymies for these three genera should be revised to include at least the significant citations that bear on the recognition of their type species.

The 10 genera for which genotypes are clarified or corrected as a result of this investigation are taken up in alphabetical order on the following pages.

Special acknowledgment is made for advice on nomenclatural problems generously given by Dr. J. Brookes Knight, of the U. S. National Museum. Access to type specimens from the American Museum of Natural History was arranged through the kindness of Dr. A. R. Loeblich, Jr., of the U. S. National Museum.

STATUS OF BATOSTOMELLA ULRICH, 1882

No type species was designated for the genus *Batostomella* at the time of original publication (Ulrich, 1882: 140–141). Four species and one variety, all previously described, were included in the genus, however; and two of these, *Chaetetes gracilis* Nicholson ex James (Nicholson, 1874a: 504) and *Calamopora tumida* Phillips (1836: 200), were described superficially. On a subsequent page of the same article (Ulrich, 1882: 154), a diagnosis of *Batostomella* was published but no type was named. Three undescribed (and unnamed) species were mentioned also by Ulrich (1882: 141) as belonging in the genus, but these presumably were not published until several years later (Ulrich, 1890a: 432–436) when he described six new species. Ulrich's generic diagnosis of 1890 (1890a: 375) is accompanied by the statement that the types of *Batostomella* are "*B. spinulosa* n. sp., and *B. gracilis* Nicholson." Between 1882 and 1890 and especially after 1890, Ulrich's concept of the genus changed, for several of the species originally included and two of those described in 1890 were placed in other genera.

When Miller (1889: 294) published a diagnosis of *Batostomella* with a list of seven species, six of which were *nomina nuda*, he designated *Chaetetes gracilis* Nicholson as genotype. Inasmuch as Ulrich's original concept of *Batostomella* as well as his 1890 interpretation of the genus was definitely based in part on *Chaetetes gracilis*, Miller's designation of this species as genotype not only fulfills the requirements of Article 30 of the Code that the type must be selected from the originally included species, but also seems to be the only practical selection that could have been made.

Subsequently Ulrich (1893: 228) assigned *Batostomella gracilis* to *Homotrypella* Ulrich (1886a: 83) and commented that the genus *Batostomella* must "be restricted to the Devonian and Carboniferous species originally intended as types." Nickles and Bassler (1900: 185) appear to be responsible for assigning the species to *Bythopora* Miller and Dyer (1878: 6), a genus antedating *Batostomella* by four years. If this generic assignment is accepted, *Batostomella* is to be considered a junior synonym of *Bythopora*. A study of the type species of these two genera, however, has raised much doubt that *Chaetetes gracilis* Nicholson is congeneric with *Bythopora fruticosa* Miller and Dyer (1878: 6–7), a junior objective synonym of *Helopora dendrina* James (1878: 3), the genotype of *Bythopora*. The present location of Nicholson's type or types is unknown, but specimens of *Bythopora gracilis* from the Maysville of Cincinnati, Ohio, in the collections of the U. S. National Museum, which agree with Nicholson's descriptions in all respects, exhibit wall structure and other characters that are typical of heterotrypid genera. This observation is strongly supported by Nicholson's descriptions and figures of what was presumably the original type material (Nicholson, 1881: 125–128). On the other hand, the wall structure of *Bythopora dendrina* (James) and several other closely related species is practically indeterminate owing to the minute size of the zoaria, obliquity of the zooecia, narrowness of the mature zone, and the consequent difficulty of preparing tangential sections adequate for study. The group of species typified by *B. dendrina* is believed to be generically distinct from the more robust species exhibiting heterotrypid wall structure, such as *Chaetetes gracilis* Nicholson and *Chaetetes meeki* James (1878: 1), whose characters are not readily comparable with those of typical species of *Bythopora*. It is therefore here considered that *Batostomella* is a valid genus of lower Paleozoic Heterotrypidae.

During the summer of 1948, after the writer's investigations of these nomenclatural problems and their taxonomic ramifications had been largely completed, copies of a paper containing a discussion of the status of *Batostomella* arrived in this country. Crockford (1947: 33–34) has reviewed the nomenclatural problem and pointed out that *Batostomella spinulosa* Ulrich is inadmissible as a genotype. Miller's designation of *Chaetetes gracilis* as type of the genus apparently did not come to her attention. Inasmuch as she did not have access to the specimens and some of the literature bearing on the *Batostomella* problem, Crockford did not attempt to correct the existing confusion, though she discussed the rejected synonyms of *Batostomella* and their inadequacy as replacing names and mentioned the need for renaming the family.

NOMENCLATURE AND TAXONOMY OF THE LATE PALEOZOIC "BATOSTOMELLID" BRYOZOA

For taxonomic purposes it is not particularly unfortunate that the name *Batostomella* must be either submerged as a junior synonym or, which is more likely, employed for a genus of early Paleozoic heterotrypid bryozoans. Paleontolo-

gists working on the Bryozoa (Ulrich, 1890a: 365; Condra, 1902: 342; 1903: 47–48, 98–99; Girty, 1907: 43; 1913: 316; 1915: 323–326; Moore, 1929: 13; Nikiforova, 1933a: 24–25) have commented on the difficulty in setting the limits of the genus and in determining the relationships of species assigned to it with those identified as belonging to other genera, some of which are not even classified in the same family or order. Some of the late Paleozoic species hitherto assigned to *Batostomella* Ulrich may be referred to other genera such as *Megacanthopora* Moore (1929: 10–13), *Dyscritella* Girty (1910: 193), *Stenopora* Lonsdale (1844: 161–162), *Stenodiscus* Crockford (1945: 21), *Rhombopora* Meek (1872: 141), and possibly other rhomboporoids.

Two genera, *Geinitzella* Waagen and Wentzel (1886: 875, 880–882) and *Batostomellina* Vinassa de Regny (1921: 227), generally have been held to be the same as *Batostomella*. The possibility of using these names for late Paleozoic *"Batostomella"* therefore must be considered. As type specimens of the genotypes are not known to have been sectioned in connection with earlier studies, our knowledge of these genotypes is based on material identified by other workers as belonging to the species.

Status of Geinitzella.—The genus *Geinitzella* has been a source of much nomenclatural and taxonomic confusion. Most paleontologists have assumed that its genotype was *Coralliolites columnaris* Schlotheim, 1813, a species referred to *Stenopora* Lonsdale, 1844, by King (1850: 28–29). It is highly probable that many of the specimens identified with Schlotheim's species do not belong in it. In fact, Schlotheim himself must have assigned more than one species to his *Coralliolites columnaris*. Schauroth (1854: 542–543) commented on this, but subsequent authors (Geinitz, 1861: 113–114; Dybowski, 1876: 6–7; 1877: 68–69) regarded Schauroth's conclusion as erroneous. In the original publication, however, Schlotheim mentioned the species as probably occurring in the Grauwackenschiefer (Schlotheim, 1813: 29) with other fossils that are presumably of Devonian age. On a subsequent page (Schlotheim, 1813: 59–60), *Coralliolites columnaris* was discussed as a fossil of the Zechstein, and this is the citation which King, Geinitz, Dybowski, and later authors all give as the original description (if it can so be construed) of the species. Schlotheim (1813: 74) also included *Coralliolites columnaris* in the faunal list for the Jurakalkstein. As is to be expected in paleontological work of this early period, Schlotheim distinguished his species on gross characters and lumped specimens from rocks of widely different ages into the same species. It is impossible to tell from the original publication just what was included in *Coralliolites columnaris*. The passage cited (Schlotheim, 1813: 59) as the original description merely states that the species is a characteristic type of coral superficially resembling and very easily confounded with the stems and columnals of crinoids. Schlotheim further commented that these forms correspond for the most part with the coral type illustrated by Picot de Lapeirouse T. X. F. 6. The figure cited (Lapeyrouse, 1781: pl. 10, fig. 6) is that of a Cretaceous rudistid. A study of Schlotheim's original "types" would be needed in order to determine the exact systematic position of the fossils he included in *Coralliolites columnaris*. No mention was found in the literature dealing with this species that the revisers had examined Schlotheim's material, and it is not known whether his "types" are extant.

King (1850: 28), in first assigning *Coralliolites columnaris* to *Stenopora*, and Geinitz (1861: 113), in extending the application of this species, appear to have included a good many forms that do not belong in the same species and some that probably do not belong in the same genus. Geinitz (1861: 114–115) further complicated matters by distinguishing several "varieties" of *Stenopora columnaris*. Examples of these "varieties" were furnished to Waagen and Wentzel (1886: 880–883), who identified some of the same forms among the specimens they described as *Geinitzella columnaris* from the Permian of the Salt Range. Waagen and Wentzel (1886: 880) stated that their genus *Geinitzella* was "founded" on *Stenopora columnaris* but did not specifically designate this species as genotype. Although most subsequent workers have considered this species to be the type, no one seems to have unequivocally designated it as such until 1935 (Bassler, 1935: 117). In the meantime, Lee (1912: 152) had selected *"Geinitzella ramosa* [sic] var. *incrustans"* as the genolectotype. The trivial name *"ramosa"* is obviously a *lapsus*, inasmuch as Lee referred to the description and figures of *Geinitzella columnaris* var. *incrustans* and name *"ramosa"* applies to another variety distinguished by Geinitz. The nomenclatural status of varieties has been a matter of dispute,

some specialists contending that a variety is not equivalent to a subspecies, the lowest nomenclatural category recognized in the present Code, and therefore is to be ignored for purposes of nomenclature. The revised Code presumably will clarify this situation by providing for the nomenclatural recognition of varieties described before 1950. Lee's selection therefore, as Crockford (1947: 34) has remarked, "must be accepted," and the genus *Geinitzella* must be interpreted on the genolectotype *Stenopora columnaris* var. *incrustans* Geinitz (1861: 114) = *Geinitzella incrustans* (Geinitz).

Even though *Geinitzella incrustans* is accorded recognition as the genolectotype, the taxonomic significance of the genus has yet to be determined. Previous interpretations of the structural characters of this species (Lee, 1912: 152; Bassler, 1929: 61; 1935: 117; Crockford, 1947: 34) seem to have been based entirely on Waagen and Wentzel's figures (Waagen and Wentzel, 1886: pl. 106, figs. 5, 6) of specimens from the Salt Range and not on Geinitz's types. Waagen and Wentzel's description and figures are inadequate for determination of generic characters, especially because no tangential section was figured and it is not possible to tell whether the tubular structures between the zooecia, shown in the longitudinal sections, are mesopores or acanthopores. Bassler (1929: 61; 1935: 117) apparently interpreted these small tubes as mesopores, inasmuch as he stated (1929) that the specimens "may represent the group for which *Dyscritella* is now employed" and (1935) that this species "seems to be the incrusting portion of a *Batostomella* without diaphragms." Crockford (1947: 34) observed that these figures show irregularly thickened zooecial walls and concluded that Waagen and Wentzel's *Geinitzella columnaris* var. *incrustans* should probably be referred to *Stenopora*. My impression is that the figures show part of a ramose stenoporoid "incrusted" with a layer of renewed growth of the same species. The feature of renewed growth in one or more layers is rather common among the stony bryozoans, including ramose and bifoliate species as well as those having massive and laminar zooaria, and certainly is not of sufficient zoological significance to differentiate a "variety" (in the sense of subspecies).

In any event, the genus should be interpreted not on specimens from the Salt Range but on Geinitz's types of *Stenopora columnaris* var. *incrustans* from the Zechstein of Germany. Unfortunately Geinitz's type specimens apparently have not been subjected to study by modern methods, and the original descriptions and figures (Geinitz, 1861: 114, pl. 21, figs. 1–6, 8, 19) are not adequate for interpretation. It is probable that more than one species is represented among the figured specimens. Dybowski's investigation (Dybowski, 1876, 1877) of the species was based on specimens in the collections of the University of Dorpat that he had identified with Geinitz's figures (Geinitz, 1861: pl. 21, fig. 19, 19A) of a specimen deposited in the Dresden Museum. Dybowski's figured specimen may be identical with Geinitz's species, but this cannot be verified by examination of the illustrations. It seems advisable, however, to here designate the specimen figured by Geinitz on plate 21, figure 19, as the lectotype of *Geinitzella incrustans* (Geinitz).

Assuming that Dybowski's material is identical with the lectotype, it is difficult to decide whether the species should be referred to *Stenopora* or recognized as belonging to a distinct genus—*Geinitzella*. Dybowski's figures appear to depict an incrusting stenoporoid with relatively abundant mesopores. *Stenopora* is commonly described as having few mesopores. It is impossible to tell whether the lectotype here chosen has mesopores, hence the uncertainty as to whether Dybowski correctly identified his specimens. Species of *Stenopora* differ considerably in the development of mesopores. In specimens of the genotype, *S. tasmaniensis* Lonsdale (1844: 161–162; see also Bassler, 1941: 173–174, figs. 5, 6), mesopores are absent or extremely rare. On the other hand, a good many of the species of *Stenopora* described and illustrated by Crockford (1943, 1945) in recent years are characterized by a moderate number of mesopores, especially in the monticules. As none of these species are incrusting or laminar forms, Crockford's studies furnish no data on the comparative development of mesopores in zooaria of this type. Among the incrusting stenoporoids described from the late Paleozoic of North America are two species that seem to be correctly identified as *Stenopora*. *S. spinulosa* Rogers (1900: 1–2) is described as having a few small mesopores, whereas *S. granulosa* Girty (1908: 128–129) is characterized by a moderate number of mesopores. Condra (1903: 41) reported that the walls of *S. spinulosa* are not moniliform. Girty's species from the Permian of the Guadalupe Mountains has definite though

few monilae in the zooecial walls (Girty, 1908: pl. 19, fig. 1c). In general, beading appears to be very much more distinct in the thinner-walled stenoporoids, and it is to be expected that thick-walled species, such as *S. spinulosa*, will not exhibit conspicuous monilae.

In light of the foregoing observations, Dybowski's figured specimens of *Stenopora columnaris* [var. *incrustans*] from the Lower Zechstein near Gera belong with the taxonomic unit now called *Stenopora*. Until the lectotype of Geinitz's species can be demonstrated to possess a different combination of characters, the name *Geinitzella* should be referred to the synonymy of *Stenopora*. Future work, of course, may show *Geinitzella* to be applicable for a subgenus of incrusting and laminar Stenoporas. At present, however, differentiation based on these zooarial habits does not seem to be advisable. As long ago as 1891, Etheridge (p. 48) expressed the opinion that the distinction between *Geinitzella* and *Stenopora* seemed to be a very artificial one. His observation is certainly supported by the published illustrations and later studies.

The suggestion (Bassler, 1929: 61) that *Geinitzella* may be a senior synonym of *Dyscritella* merits no serious consideration, for there is not the slightest indication that in the type species of *Geinitzella* mesopores even approach the abundance characteristic of the leioclemoid genus *Dyscritella*. The specimens illustrated by Waagen and Wentzel (1886: 883, pl. 113, figs. 3, 4) as "*Geinitzella columnaris* var. *ramosa multigemmata*" may indeed prove to be a species of *Dyscritella;* but for the present at least, the other specimens Waagen and Wentzel figured as *Geinitzella crassa* (which most certainly is not specifically identical with *Stenopora crassa* Lonsdale, 1845: 632) and varieties of *G. incrustans* may conveniently be assigned to *Stenopora*.

Other species, mostly from Russia and Asia, that have been assigned to *Geinitzella* probably will be found to belong to *Stenopora, Stenodiscus, Rhombotrypella* Nikiforova (1933a: 36), or other stenoporoid genera. *Geinitzella chinensis*, described by Girty (1907: 42; 1913: 315, pl. 28, figs. 9–14) from the Permian of China, is a *Stenodiscus* with mesoporelike acanthopores. Likewise, the three species, *Batostomella* (*Geinitzella*) *hayasakai*, *B.* (*Geinitzella*) *yunnanensis*, and *B.* (*Geinitzella*) *manchuriensis*, recently described by Yabe and Sugiyama (1942: 406–414) from the lower Permian of China are probably *Stenodiscus*. The wall structure of these species is not discussed and the figures are very inadequate, but indications are that this is the most logical generic assignment.

Status of Batostomellina.—This name, introduced by Vinassa de Regny (1921: 227) for a subgenus of *Batostomella*, has never gained acceptance. Bassler (1935: 54, 55) considered it to be a junior synonym of *Batostomella*, for the genotype, *Trematopora granulifera* Hall (1852: 154, pl. 40A, figs. 9a–e), had been referred to *Batostomella* by Nickles and Bassler (1900: 180) and later was redescribed and refigured by Bassler (1906a: 28–29, pl. 13, figs. 1–5, pl. 24, figs. 10, 11, pl. 25, figs. 11, 12).

In connection with the present investigation, thin sections were prepared of Hall's types of *Trematopora granulifera*. From among the cotypes included in American Museum of Natural History Cat. No. 1757, the specimen figured by Hall (1852: pl. 40A, fig. 9e) and refigured by Bassler (1906a: pl. 24, fig. 10) is here selected as lectotype of the species. Thin sections show the type to be identical with the topotypes (U. S. Nat. Mus. no. 35517) figured by Bassler (1906a: pl. 13, figs. 1–5).

A study of the excellent sections prepared by Bassler shows that the general features of *Trematopora granulifera* are accurately described and figured. However, examination at higher magnifications than those used for Bassler's illustrations has revealed some features not hitherto described. First, the wall structure of this species is not comparable to that of the later Paleozoic "Batostomellidae." The zooecial walls are rather vague and not distinctly laminated and appear to be more like those of *Trematopora tuberculata* Hall (1852: 149), the genotype of *Trematopora* Hall (1852: 149). The possibility was considered that this similarity was deceiving and due to conditions of preservation, inasmuch as both *T. tuberculata* and *T. granulifera* occur in the Rochester shale at Lockport, N. Y.; but other species from the same locality and horizon do not support that interpretation. Both *Trematopora tuberculata* and *T. granulifera* have very narrow mature zones, lack diaphragms in the zooecia, and possess abundant mesopores, which are closed at the surface. In *T. tuberculata* the mesopores are beaded, whereas in *T. granulifera* they are so obscured by acanthopores that it is impossible to be sure whether diaphragms are completely absent.

The most distinctive features of *T. granulifera*, however, are to be noted in the acanthopores. These structures are extremely abundant and near the surface completely obscure the mesopores. In comparison with the zooecia, the acanthopore tubes are relatively large, closed at the surface but hollow through most of their length and lined with minute mural spines. These tiny spines give a ragged hazy appearance to the walls in the mature region. Bassler's figures (Bassler, 1906a: pl. 13, figs. 4, 5) give some impression of this condition, but the cause was apparently not observed or described.

As a result of the present study, *Batostomellina* Vinassa de Regny should be restored as a generic name for lower Paleozoic trepostomatous bryozoans. The genotype appears to be allied to *Trematopora*; and, for the time being, the genus may be assigned to the Trematoporidae, a family that no doubt needs revision along with the other trepostomatous families established more than half a century ago.

The three other species assigned to *Batostomellina* by Vinassa de Regny (1921: 227) most certainly are not related to *B. granulifera* (Hall). *Dyscritella ambigua* Lee (1912: 181, pl. 16, figs. 11, 12) may be correctly assigned to *Dyscritella*—in any event it appears to be a leioclemoid or a stenoporoid bryozoan. *Bythopora parvula* (James, 1878: 3; see also Bassler, 1906: 22, pl. 3, figs. 11, 12, pl. 5, fig. 4) appears to be a *Bythopora* though it possesses some cryptostomatous features. *Batostomella interporosa* Ulrich and Bassler (1913: 270–271, pl. 45, figs. 1, 2, pl. 48, fig. 5) resembles the type of *Dyscritella* in many respects, and for the time being may be considered a delicate species of that genus.

Aside from the genotype, the writer does not know of any described species that should be assigned to *Batostomellina*. It is not expected that the name will be applicable for any species of "batostomellid" bryozoans from the late Paleozoic.

Systematic position of "Batostomella" spinulosa.—Much of the difficulty experienced by previous workers in dealing with the genus "*Batostomella*" and the group of genera included in the family "Batostomellidae" is directly attributable to Ulrich's faulty interpretation of *B. spinulosa*. In the collections of the U. S. National Museum are two slides of the figured sections (Ulrich, 1890a: pl. 75, figs. 1d, e, f), one bearing the tangential and longitudinal sections illustrated in figures 1d and 1e and the other the longitudinal section shown in figure 1f. Sections 1d and 1e were made presumably from the same specimen, but there is no way of knowing whether section 1f came from the same fragment. In section 1f, diaphragms are lacking in the zooecial tubes. Unfortunately there is no tangential section to compare with the tangential on the other slide. The sections figured as 1d and 1e were partly shattered in mounting, and the longitudinal especially is too thick for microscope examination. Rather abundant diaphragms are shown in Ulrich's figure 1e. In the immature region, at least, calcite cleavage cracks were misinterpreted as diaphragms. A few diaphragms are present in the transition zone and mature region of some zooecia, but most of the diaphragms illustrated in this figure are cracks or strands of dense zooecial deposits. The diaphragms shown in some mesopores on the left side of figure 1e cannot be identified in the section. In the description of this species Ulrich (1890a: 434–435) reports the mesopores to be moderately abundant. Actually they are relatively few, very inconspicuous, and mostly no larger than the acanthopores.

As Ulrich's figured sections of this species are inadequate for study and interpretation of its characters, and as a type for this species has never been named, a lectotype (U.S.N.M. no. 114344) has been chosen from the specimens labeled by Ulrich as his cotypes. This specimen has been sectioned and without doubt is identical with the species figured by Ulrich (1890a: pl. 75, figs. 1d, 1e).

The newly made thin sections of the lectotype amply confirm the preceding statements about the occurrence of diaphragms. None are present in the mesopores or in the immature region. A very few zooecia have a single diaphragm in the transition zone. A longitudinal section through an older part of the zooarium shows that approximately half the zooecia contain one or two, occasionally three, diaphragms in the mature region. A longitudinal section through a younger part of the zooarium exhibits very few diaphragms; in fact they are absent in most of the zooecia. It seems possible that diaphragms may have been developed in the ephebic growth stages, an explanation that would account for their variable distribution in different parts of the zooarium. The longitudinal section lacking diaphragms that was figured by Ulrich (1890a: pl. 75, fig. 1f) may well have cut the growing end of a branch.

A tendency toward intermittent thickening of the zooecial walls in the transition zone and early mature region is to be observed, especially in the older part of the zooarium. Other specific characters were adequately described and figured by Ulrich and need not be repeated here.

Many of the Carboniferous species that have been assigned to "*Batostomella*" and that seem to be rather closely allied to "*B.*" *spinulosa* possess features, such as intermittently thickened or moniliform walls and perforated diaphragms, that are commonly held to be stenoporoid. Some of these species perhaps should be more correctly assigned to *Stenopora* Lonsdale, *Tabulipora* Young (1883: 154; see also Lee, 1912: 149), *Stenodiscus* Crockford, and allied genera. At the present state of our knowledge, it would be difficult to formulate a definition for a genus that would encompass the late Paleozoic species generally referred to "*Batostomella*" without transgressing limits set for several other genera. The erection of a new genus for the group of species more or less typified by "*B.*" *spinulosa* does not seem wise at this time. In the event a new genus is defined, it would be well to avoid naming "*B.*" *spinulosa* or any of the other species described by Ulrich in 1890 as genotype, because we have only vague locality data for these species, and their geologic horizons are somewhat indefinite. It has not been possible to examine and evaluate all the species described from North America, the number of which is insignificant in comparison with the known but undescribed species and the abundant material still unstudied, which is expected to increase our information on this group manifold. Until comprehensive studies can be made of skeletal structures, variation, and evolutionary trends in the stenoporoids, rhomboporoids, and "bastostomellids," the introduction of a single new generic name for this poorly understood group will serve no useful purpose. For the present it will suffice to retain most of the described species in "*Batostomella*."

Revised classification of the "batostomellid" Bryozoa.—Whether the name *Batostomella* is recognized for an early Paleozoic genus of probable heterotrypid affinity or held to be a synonym of *Bythopora*, the family name Batostomellidae proposed by Ulrich (1890a: 341, 375; see also Miller, 1889: 290) is no longer tenable for those genera commonly described as stenoporoid or leioclemoid. Some might argue that the family name should become accordingly Bythoporidae; but *Bythopora* Miller and Dyer, *Eridotrypa* Ulrich (1893: 264), and some other genera, based on genotypes of Ordovician age and known exclusively from the lower Paleozoic, are not in the least typical of the large group of genera now included in the family, nearly all of which are confined to later rocks. Both *Bythopora* and *Eridotrypa*, which are similar in many ways, appear to be closely allied to the Heterotrypidae, though revision may show the need for recognizing a separate family for these two and some other related lower Paleozoic genera.

The problem of basic relationships was confused originally by Ulrich's inclusion of two very different types of bryozoans in his genus *Batostomella*, the type of the family. One of his "types," "*B.*" *spinulosa*, was obviously related to species grading into the stenoporoids and rhomboporoids, whereas the actual type, *B. gracilis* (Nicholson), superficially resembles some species of *Bythopora*. For this reason, no doubt, *Bythopora* was originally placed in the family along with *Batostomella*, *Stenopora*, *Anisotrypa* Ulrich (1883: 275–276), *Callotrypa* Hall and Simpson (1887: xvi), and *Leioclema* Ulrich (1882: 141). After Ulrich (1893: 228) referred *Batostomella gracilis* to *Homotrypella*, a monticuliporoid bryozoan, and *B. simulatrix* Ulrich (1890a: 432–433), another Ordovician species, to *Eridotrypa* (see Ulrich, 1893: 265), the premises for assuming there was a systematic gradation from the early to the late Paleozoic "batostomellid" genera were nullified. Even Ulrich (1893: 265) recognized this when he wrote of *Eridotrypa*, "The systematic position of the genus, though in a measure doubtful, is probably intermediate between *Homotrypa* (compare *H. similis* Foord) of the Monticuliporidae, and *Bythopora* Miller and Dyer, of the Batostomellidae. Because of the absence of cystiphragms it will be best to embrace the genus provisionally in the latter family."

Though Ulrich realized originally that he had included an "incongruous assemblage" of genera in his family Batostomellidae and indicated a few years later that his ideas about relationships and phylogeny had changed considerably, he apparently felt that published knowledge was too scant to substantiate a radical redistribution of genera and revision of the family classification. In any event, *Bythopora* and *Eridotrypa* were left in the family Batostomellidae, as it was then understood, and have been retained there until the present in spite of our greatly increased knowl-

edge of the later Paleozoic Trepostomata and their relationships.

Of the other genera Ulrich included in the family, *Stenopora*, *Anisotrypa*, and *Leioclema*, though representing rather diverse structural types, appear to be related through a series of transitional genera, and consequently their inclusion in the same supergeneric division can be reconciled. The systematic relationships of *Callotrypa* are uncertain, because its genotype has never been critically studied. Likewise, *Trematella* Hall (1886: expl. pl. 25), which Ulrich (1893: 264) considered to be a synonym of *Batostomella*, has never been adequately studied and its taxonomic position is undetermined.

Since 1893 a large number of genera based mostly on Devonian and post-Devonian species have been assigned to the family "Batostomellidae." Two Ordovician genera, *Esthoniopora* Bassler (1911: 259) and *Orbipora* Eichwald (1856: 92), have been called primitive stenoporoids, but they differ so obviously from the typical late Paleozoic forms that they may well belong elsewhere in the classification. *Koninckopora* Lee (1912: 152) has for a genotype a species that has been demonstrated (Wood, 1943: 205–221) to be an alga and is therefore eliminated. Left in the family are more than a score of genera that seem to be closely related to divisions we may conveniently designate the *Stenopora* and *Leioclema* groups. As a few genera are transitional between the two main structural divisions, the establishment of two families is not feasible. Inasmuch as the name Batostomellidae is inapplicable, a new name is needed. The family Stenoporidae is here proposed, not as an exact substitute for the family Batostomellidae as it commonly has been applied, but as a taxonomic division that will include the *Stenopora* and *Leioclema* types of trepostomatous bryozoans.

A point of priority is involved in proposing the name Stenoporidae for a bryozoan family. Waagen and Wentzel (1886: 873, 875) originally introduced the subfamily Stenoporinae as a division of the Monticuliporidae (a name early students used generally for the stony bryozoans) several years prior to Ulrich's publication of the family name Batostomellidae. Ulrich apparently was unaware of Waagen and Wentzel's work when he prepared the manuscript for the Geological Survey of Illinois Volume VIII. Etheridge (1891: 31) adopted the subfamily Stenoporinae as a convenient taxonomic division, but it seems to have been ignored by paleontologists ever since even though many genera are commonly referred to as stenoporoids. The name *Stenopora* has been widely used for many stenoporoid species, especially in earlier work before the generic distinctions now recognized were observed. Though now restricted, the genus is one of the best established and most characteristic of the group, and it is most appropriately chosen as type of the family.

STENOPORIDAE, n. fam.

Definition.—Trepostomatous Bryozoa characterized by distinctly laminated, generally amalgamate zooecial walls. Zooaria of variable habit—ramose, massive, incrusting, frondescent, and bifoliate.

Stenoporoid genera distinguished typically by irregularly thickened walls in the mature region, the thickening being intermittent in primitive types and trending to conspicuous beading in advanced forms. Mesopores not abundant in most genera. Acanthopores commonly very abundant and conspicuous. Diaphragms generally complete in primitive forms; commonly perforated, incomplete, or lacking in more advanced genera.

Leioclemoid genera characterized typically by rather uniformly thickened and comparatively thin zooecial walls in the mature region. Mesopores abundant, generally completely isolating the zooecia. Acanthopores generally abundant but, owing to the excessive number of mesopores, usually less conspicuous than in the stenoporoids. Diaphragms variable in occurrence and type; complete or absent in the mesopores; typically complete in the zooecia, but perforated or lacking in some genera and species.

Remarks.—A few genera, which appear to be transitional or highly specialized forms, possess some characters that are diagnostic of the stenoporoids and others that are distinctly leioclemoid. For example, certain species that have been assigned to *Leioclema* and allied genera have intermittently thickened or beaded walls and others have perforated diaphragms. On the other hand, several predominantly stenoporoid genera possess mesopores in an abundance comparable to that of the leioclemoids.

A few of the genera in the following list are included in the family Stenoporidae with considerable doubt. Typical *Anisotrypa* (some of the species assigned to this genus probably are more

properly referable to *Tabulipora*), *Callocladia*, *Coeloclemis*, and *Syringoclemis* all have some cryptostomatous features.

As outlined in the preceding discussion, *Batostomella*, *Bythopora*, *Eridotrypa*, *Esthoniopora*, and *Orbipora* appear to have no close relationships with the Stenoporidae. *Koninckopora* is not a bryozoan. *Callotrypa* and *Trematella* are at present too poorly known to be used taxonomically, and their genotypes will have to be studied before family assignments can be made. *Lioclemella* possesses none of the diagnostic characters of the Stenoporidae, and its systematic position is uncertain.

Of the genera listed, only *Leioclema* is at present accommodating Ordovician and Silurian species. A study of the thin sections of most of the lower Paleozoic species that have been assigned to *Leioclema* casts much doubt on the appropriateness of referring most, if not all, of these species to the genus. It is difficult to reconcile the wall structure and various other features exhibited by these earlier Paleozoic forms with the morphology of the Lower Carboniferous genotype *Leioclema punctatum* (Hall, 1858: 653). One can only conclude that the Ordovician and Silurian species are examples of homeomorphy and were derived from several different stocks. Some of these species appear to have relationships with *Nicholsonella* Ulrich in Miller (1889: 313), others with *Hallopora* Bassler (1911: 325), and still others with such monticuliporoids as *Homotrypella* Ulrich (1886a: 83) and *Atactoporella* Ulrich (1883: 247). Careful study of the lower Paleozoic species now included in *Leioclema* will probably demonstrate the need for establishing several genera in order to avoid a polyphyletic genus.

Range.—Silurian?, Devonian-Permian.

Genera of the Stenoporidae.—

Amphiporella Girty, 1910.
Anisotrypa Ulrich, 1883.
"*Batostomella*" Ulrich, 1890 (non *Batostomella* Ulrich, 1882).
Calacanthopora Duncan, 1939.
Callocladia Girty, 1910.
Chondraulus Duncan, 1939.
Coeloclemis Girty, 1910.
Diplostenopora Ulrich and Bassler, 1913.
Dyoidophragma Duncan, 1939.
Dyscritella Girty, 1910.
Eostenopora Duncan, 1939.
Leeporina Vinassa de Regny, 1921.
Leioclema Ulrich, 1882 (objective synonym: *Lioclema* Ulrich, 1896; subjective synonym?: *Thallostigma* Hall, 1883).
Liopora Girty, 1915.
Megacanthopora Moore, 1929.
Microcampylus Duncan, 1939.
Pycnopora Girty, 1910.
Rhombotrypella Nikiforova, 1933.
Stenocladia Girty, 1910.
Stenodiscus Crockford, 1945.
Stenophragma Munro, 1912.
Stenopora Lonsdale, 1844 (subjective synonyms: ?*Tubuliclidia* Lonsdale, 1845[1]; ?*Geinitzella* Waagen and Wentzel, 1886; *Ulrichotrypa* Bassler, 1929).
Stenoporella Bassler, 1936.
Stereotoechus Duncan, 1939.
Syringoclemis Girty, 1910.
Tabulipora Young, 1883.
Tabuliporella Nikiforova, 1933.
Trachytoechus Duncan, 1939.

DICHOTRYPA ULRICH IN MILLER, 1889

Although Ulrich (1890a: 386) designated *D. foliata* Ulrich (1890a: 499) as type of the genus, the prior publication of a generic diagnosis in Miller (1889: 300) with a list of the species Ulrich intended to include in the genus, all but one of which were *nomina nuda*, makes that designation invalid. *Fistulipora flabellum* Rominger (1866: 122) was the only included species for which a description had been published in 1889. Therefore, under Article 30 *Dichotrypa* is a monotypical genus taking *D. flabella* (Rominger) as its type. So far as can be determined, the recognition of this species as genotype does not create a zoologic problem, and the generic concept is essentially unchanged.

[1] The name *Tubuliclidia* was originally published (Murchison and Verneuil, 1844: 497–498) in connection with two undescribed species listed in a faunal chart. It was therefore a *nomen nudum* and had no status (under the present Code and Opinion 53) until the following year, when Lonsdale (1845: 631) noted that he preferred to use the name *Stenopora* for the genus. *Tubuliclidia* has been cited in some synonymies of *Stenopora*, and it seems to have been assumed that *S. tasmaniensis* Lonsdale (see Bassler, 1935: 222) was the genotype. This species, however, was not one of the two originally assigned to *Tubuliclidia*, and moreover it came from a different continent. According to current interpretation of the Code, *S. tasmaniensis* is inadmissible as type. Unfortunately neither *Stenopora spinigera* Lonsdale (1845: 632) nor *S. crassa* Lonsdale (1845: 632), which were originally included in *Tubuliclidia*, have been carefully studied, and the possibility exists that these two species do not belong to *Stenopora*. Inasmuch as the original figures and description of *Stenopora crassa* = *Tubuliclidia crassa* indicate good possibility of its being a *Stenopora*, this species is here designated type of the genus *Tubuliclidia* in the hope that the name can be demonstrated eventually to be a subjective synonym if the revised Code does not provide for rejecting it as a junior objective synonym.

LYROPORA HALL, 1857

Hall (1857: 179) originally distinguished *Lyropora* as a subgenus of *Fenestella* and described three species but did not designate a genotype. Subsequent authors (Ulrich, 1882: 150; Claypole, 1883: 32; Hall, 1885: 37; Waagen and Pichl, 1885: 773; Ulrich, 1886: 5) who recognized and discussed this genus failed to select a genotype. Therefore Miller's designation (1889: 312) of *Lyropora lyra* Hall (1857: 179) as type of the genus must stand. Ulrich (1890a: 583) considered *L. lyra* to be a slightly modified form of *L. subquadrans* Hall (1857: 180) differing so little from that species that it could not even be distinguished as a variety. Nickles and Bassler (1900: 311) list the *L. lyra* form as *Lyropora subquadrans-lyra* (Hall). Bassler (1935: 142) cites *Fenestella* (*Lyropora*) *subquadrans* Hall, 1857, as type of the genus. Whether referring *L. lyra* to synonymy with *L. subquadrans* is a legitimate procedure can be determined only from a study of the type specimens, which apparently were not examined by Ulrich or later workers. In any event, the type citation should be *Fenestella* (*Lyropora*) *lyra* Hall, a species which may be identical with *Fenestella* (*Lyropora*) *subquadrans* Hall. Under the circumstances, it would seem more appropriate to consider *L. subquadrans* a possible synonym of *L. lyra*.

MEEKOPORA ULRICH IN MILLER, 1889

Ulrich's designation (1890a: 383) of *Meekopora eximia* Ulrich (1890a: 483–484) as type of this genus is invalid owing to the fact that Miller (1889: 312–313) originally published the generic diagnosis in connection with a single previously described species, *Fistulipora? clausa* Ulrich (1884: 47). *Meekopora* is therefore a monotypical genus having *M. clausa* (Ulrich) as its type species. Inasmuch as *M. clausa* is a well-known and very typical species of *Meekopora*, no change in generic concept is required.

NEMATOPORA ULRICH, 1888

This genus was first proposed by Ulrich in 1888 (231, 234) although it was recorded as new in 1890 (Ulrich, 1890a: 401) with *N. quadrata* Ulrich (1890a: 644–645) designated as type. Miller (1889: 313) followed Ulrich (in press), giving a generic diagnosis with *N. quadrata* as type of the genus and listing three other species, all being *nomina nuda* in 1889. Neither Miller in 1889 nor Ulrich in 1890 makes any reference to the publication in which Ulrich (1888: 231, 232, 234) first proposed the generic name, gave the characters distinguishing the genus from others included in the family Arthrostylidae, and definitely assigned to *Nematopora* two previously described species, *Helopora lineata* Billings (1866: 36–37) and *Trematopora minuta* Hall = *Trematopora? (Trachypora?) minuta* Hall (1876: pl. 11, fig. 8). Although Ulrich (1888: 231) stated, "This genus together with a number of species will be described in vol. viii, Illinois geological survey, now in press," he obviously published the name in 1888 with sufficient information to distinguish the genus from related forms. As Ulrich's intended type was not named or differentiated from other species in 1888, one of the two valid species originally assigned to the genus must be chosen genolectotype. Therefore *Nematopora minuta* (Hall) is here selected type of the genus, supplanting *N. quadrata* Ulrich, which was later (Ulrich, 1893: 204–205) held to be identical with *N. ovalis* Ulrich (1890: 197), the description of which had been published a few months earlier.

As far as is known, *Nematopora minuta* (Hall) is congeneric with *N. ovalis* = *N. quadrata* Ulrich, and the designation of Hall's species as type of the genus probably will not require any revision of the present generic diagnosis.

PTYLOPORA McCOY, 1844

The genotype, *Ptylopora pluma* McCoy (1844: 200), is apparently cited correctly by Nickles and Bassler (1900: 382) and Bassler (1935: 179), though this fact could not be ascertained from a review of the references listed in these synonymies. McCoy described two species at the time he defined the genus but failed to designate a genotype. An investigation of the articles cited in Nickles and Bassler revealed that the monograph by Hall and Simpson (1887: xxiv) was the first reference that named a genotype—*Retepora flustriformis* Phillips, one of the two available species. Miller cited the same species in 1889 (319), and Ulrich (1890a: 398) gave "(?) Type: *Retepora flustriformis* Phillips." The question therefore arose as to why *Ptylopora pluma* was cited as type of the genus in later publications, and the literature published prior to 1887 was searched in order to find an explanation for the discrepancy.

As the two standard synonymies do not list the publication in which *P. pluma* was first named the type of the genus, students should add this

essential reference. Vine in 1884 (189, 191) cited *P. pluma* McCoy, the other of the two available species, as the "accepted type" and "type" of "*Ptilopora.*" So far as the writer has been able to find, Vine's paper of 1884 was the first to definitely name a type species for *Ptylopora*, and this article antedates by several years the American publications noted above in which *P. flustriformis* was cited as type. This circumstance is fortunate inasmuch as Shrubsole (1879: 278–279; 1881: 181), after a careful review of the species of British Carboniferous Fenestellidae, concluded that *Fenestella flustriformis* = *Retepora flustriformis* Phillips (1836: 198–199) was based on the "cast only of the reverse face" of *Fenestella plebeia* McCoy (1844: 203). If *Retepora flustriformis* Phillips had been a valid selection, *Ptylopora* would have to be referred to the synonymy of *Fenestella* Lonsdale (1839: 677–678), a preoccupied name for which suspension of the Rules has been requested (Science, n. s., **106** (2763): 585).

STREBLOTRYPA VINE EX ULRICH, 1885

Vine (1885: 391) first published the name *Streblotrypa* in connection with Ulrich's manuscript species *S. "nicklisi,"* specimens of which had been sent to him by J. M. Nickles. Vine also identified a fragment from the Carboniferous of Yorkshire with Nickles's material from the Chester group of Kaskaskia, Ill. Although Vine did not give a generic diagnosis, he did compare and figure the British and American specimens and described some of the characters, thereby validating the name. Bibliographies and synonymies (Nickles and Bassler, 1900: 420; Bassler, 1935: 210) credit the name *Streblotrypa* to Ulrich, 1890. There can be no doubt, however, that Vine was responsible for the original publication in 1885, and in an article published the following year (Vine, 1886: 96–97) he noted additional occurrences of *S. nicklesi* [erroneously spelled *"nicklisi"*], described a new species of the genus, and made some comments intended to justify his publication of Ulrich's manuscript name for which he had been criticized. Ulrich himself in 1888 (Ulrich, 1888a: 84–89) published descriptions of eight species of *Streblotrypa*, but not of *S. nicklesi*. If Vine had not previously published a description of the species that Ulrich intended should be the type of the genus, one of Ulrich's species of 1888 or *Ceriopora? hamiltonensis* Nicholson (1874: 161), which was referred to *Streblotrypa* in the same publication, would be the genosyntypes. A diagnosis of the genus was published by Miller (1889: 325), who took his data from Ulrich's 1890 monograph, then in press.

Fortunately Vine's concept of the genus and species was based mainly on material furnished to him by Nickles from the Chester group of Kaskaskia, Ill. Vine had only one fragment from Yorkshire, and this was subsequently reported lost (Vine, 1890: 191). In order to stabilize the nomenclature of *Streblotrypa nicklesi* Vine ex Ulrich, 1885, and exclude from further consideration the "lost" specimen from Yorkshire, which probably was not identical with the American specimens, this occasion is taken to designate the American specimens as types of the species. The present location of Vine's type specimens is unknown, but the suite of topotypes that Nickles submitted to Ulrich is catalogued under U.S.N.M. no. 43311 (Merrill, 1905: 630).

TAENIODICTYA ULRICH, 1888

Ulrich first published this name in connection with his description of *Taeniodictya interpolata* Ulrich (1888a: 80) from the Cuyahoga "shales" of Ohio. The generic name therefore dates from 1888 and not from 1889, when the generic diagnosis was first published by Miller (1889: 327), or 1890, when Ulrich's monograph was published (Ulrich, 1890a: 393). As only one species was described when Ulrich originally published the name, the genus is monotypical, with *T. interpolata* taken as the type under Article 30-Ic. When Miller published the first diagnosis in 1889, he followed Ulrich in designating *T. ramulosa* Ulrich (1890a: 528–529) as type of the genus and listed four other species and one variety. All the specific names except that of *T. interpolata* were *nomina nuda*, so the genus was still monotypical at that date.

In some respects *Taeniodictya interpolata* differs from what Ulrich called "typical species" of the genus (Ulrich, 1888a: 80). Future investigators therefore may find it necessary to revise the generic concept.

TREMATELLA HALL, 1886

The genotype commonly cited for *Trematella*, i.e., *Trematopora? annulata* Hall (1883: 147), is not admissible under Article 30 as interpreted in Opinion 7. Hall (1886: expl. pl. 25, figs. 4, 5) used the expression "nov. sub. gen. et sp." in connection with the species *Trematella glomerata.*

As neither of the two other species—*Trematopora arborea* Hall (1883: 147) and *Trematopora? annulata*—referred to *Trematella* in this publication were specifically named type of the genus, *Trematella glomerata* is to be recognized as the type by original designation. The selection of *Trematella annulata* by Hall and Simpson (1887: xiv) is consequently inacceptable.

WORTHENOPORA ULRICH IN MILLER, 1889

Owing to Miller's publication (1889: 330) of Ulrich's diagnosis with mention of the two species Ulrich intended to include in the genus, *Flustra spatulata* Prout (1859: 446) will have to be recognized as genotype. The other species, *Worthenopora spinosa* Ulrich (1890a: 669–670), which was cited as type, was undescribed and therefore unavailable.

So far as is known, recognition of *Worthenopora spatulata* (Prout) as type of the genus will not result in any change in morphologic concept.

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ORNITHOLOGY.—*Geographical variation in the American redstart* (Setophaga ruticilla).[1] ALEXANDER WETMORE, Smithsonian Institution.

Division of the common and widely ranging American redstart, *Setophaga ruticilla* (Linnaeus), was first proposed by Oberholser,[2] who separated the birds of northwestern Canada, stating that "this western race differs from the eastern form in smaller size, smaller orange or yellow wing-spot; in the female also in paler, more grayish, less conspicuously olivaceous, upper surface." After a careful study of material available in the National Museum in 1939, the writer, however, came to the conclusion[3] that the suggested characters did not hold, and so regarded the species as indivisible. Recently Burleigh and Peters,[4] after examination of specimens from Newfoundland, conclude that there is a northern race extending across Canada that is different from the birds of southern range.

Though the collection of redstarts in the National Museum in 1939 when I first examined this problem was extensive, most of the breeding specimens from the south had been collected in the month of May. It is well known now that with species like the present one, with a considerable population that nests in the forests of northern Canada, spring migration of the northern group may be delayed later than was formerly understood, so that during May many individuals are still enroute to their northern breeding grounds. As a few casual examples relating to the species here under discussion, I have record of personal observation of redstarts near Nazaret, on the Guajira Peninsula, northeastern Colombia, on April 30, 1941, and of specimens taken at Escorial, Mérida, Venezuela, April 30, 1903, near Port-au-Prince, Haiti, May 9 and 10, 1866, in Petén, northern Guatemala, May 3, 1923, and on Amelia Island, Florida, May 10, 1905. There are so many of these reports that they can not refer to casual individuals that for some reason would not migrate, but rather it is apparent that they are birds that would nest in the far north where their nesting grounds are not open to them because of cold until the end of May. They are therefore in passage through the United States when their southern representatives are on their nesting grounds. Collections made in the month of May thus may contain a mixture of northern and southern individuals. This has led to confusion in attempts to separate a northern form.

To examine the matter of geographic variation I have selected from our large series the adult birds collected in June and July, when all were certainly on their breeding grounds. Much material taken in these two months has been added in recent years, especially from collections made by Burleigh in Mississippi and Georgia, and by Burleigh and Peters in Newfoundland, Nova Scotia, and New Brunswick, with numerous others from other sources. First comparisons were made entirely with this series, which included 69 adult males, 50 adult females, and 27 breeding males still in immature dress, covering the area from Louisiana and Georgia to Mackenzie and Newfoundland. These findings were checked subsequently with the considerable series of redstarts in the American Museum of Natural History, which I have examined through the courtesy of the Department of Birds of that institution.

It may be said at once that adult males from the far north and the far south, and from eastern and western localities, may not be distinguished with certainty on any character, or combination of characters. My first opinion, made in 1939, on a much smaller series of males thus still holds. Size, within the usual limits of individual variation, is identical in the various areas. This is easily illustrated by the following figures on wing length taken from birds (all males) collected in June and early in July, when they were on their breeding grounds:

[1] Received February 16, 1949.
[2] Louisiana Dept. Cons. Bull. **28**: 572–573. 1938.
[3] Proc. U. S. Nat. Mus. **88**: 561–562. 1940.
[4] Proc. Biol. Soc. Washington **61**: 121. 1948.

		Mm.
14	from Alberta and Mackenzie	61.5–65.6
11	from Newfoundland	64.6–67.9
7	from Nova Scotia and New Brunswick	63.0–66.3
5	from Montana, Washington, and British Columbia	62.9–64.4
18	from Maryland, Pennsylvania, and Kentucky	62.2–67.3
8	from Georgia and Mississippi	62.3–66.5

The other usual measurements of length of tail, culmen from base, and tarsus show equal agreement.

The other principal difference that has been proposed to separate adult males is that of the size of the orange-colored spot on the wing. This is formed by orange markings that extend on the outer webs of part of the remiges from the base for an area of varying length toward the tip. This marking is always present on the secondaries but varies in extent on the primaries. In some it is found on all the primaries, while in others it is absent on these feathers except for a very faint indication at the extreme base. The basal section is concealed by the overlying coverts, the apparent extent of this coverage on the secondaries in museum skins depending in some specimens on disarrangement of the feathers, where the preparator has stripped the quills of the secondaries loose from their proper attachment on the ulna (a pernicious and unnecessary procedure that may lead to uncertainty or error in study of the relation of relative length of the feathers or of their markings). The size of the spot may be judged best by examining its extension across the primaries, and by the distance from its posterior margin to the distal tips of the longest primaries. The series at hand shows birds with small wing spots and large wing spots throughout the entire range of the species. There seems to be a tendency for more birds to have a reduced wing spot in the north, but this is not fixed, as birds with large spots and small wing spots are found indiscriminately from Mississippi and Georgia to northern Canada. Adult males, therefore, may not be separated geographically on any trenchant characters.

On examination of the excellent series of females now available it is found that those from the north are slightly darker gray above, while those from the south are faintly lighter gray and slightly more greenish. This distinction is evident also in males in immature dress that resemble the female, though in these the size of the wing spot is variable as in adults. The darker color of northern birds is slightly emphasized in immature males and females in fresh fall plumage. In this stage the northern specimens, while greenish on the back, are less so than birds from the southern sections.

Müller's description of *Motacilla tricolora*, which reads "oben ist sie schwarz, unten weiss, in den Seiten und an der Wurzel der Ruderfedern gelb, auch haben die Flügel fünf gelbe Flecken," refers to an adult male bird and thus might be either of the two subspecies here under discussion. Oberholser, however, as first reviser, has allocated the name to the northern race, an action that must be recognized under our rules of nomenclature.

In the two forms here recognized the northern one nests in general through the northern part of the Canadian Zone, and the southern one through the Transition and Austroriparian Life Zones, extending north into part of the southern area of the Canadian Zone. The two will stand as follows:

Setophaga ruticilla ruticilla (Linnaeus): Southern Redstart

Motacilla Ruticilla Linnaeus, Syst. Nat., ed. 10, 1: 186. 1758. (Virginia.)

Females and immature males somewhat lighter gray above, washed with somewhat brighter green on the back; adult males not separable.

Breeds from Minnesota, Wisconsin, Michigan, southern Ontario (Hamilton), New York, Vermont (Newfane), New Hampshire (Hollis), and southern Maine (Big Lake in Washington County, Andover, Auburn, Eliot) south to southeastern Louisiana, central Mississippi, central Alabama, and central Georgia.

Recorded in migration and winter to southern Texas (San Antonio, Pecos City, Lomita, Brownsville), the Gulf coast of Louisiana, Mississippi, and Alabama, Florida, British Honduras (El Cayo), Guatemala (Panajachel, Chimoxan, Finca Chama, Alto Vera Paz), Costa Rica (Angostura, Naranjo), Panamá (Boquerón, Boquete in Chiriquí, San José Island, and Mount Tacarcuna,

Darién), Bahama Islands (New Providence), Cuba (Mariel, Guamá, Monte Verde), Jamaica (Trelawney, St. Andrews, Falmouth, Spanish Town), Haiti (Gonave Island, Port-au-Prince, Petites Cayemites), Dominican Republic (Azua, Sánchez), Puerto Rico (Mayagüez, Anegado Lagoon, Río Piedras, Mameyes), Culebra Island, St. Thomas, St. John, Saba, St. Vincent, St. Lucia, Antigua, Sombrero, Barbuda, Montserrat, Guadeloupe, Dominica, Trinidad, Colombia (many records), throughout Ecuador (Ibarra, Zamora, Mindo, Esmeraldas, Papallacta), and Venezuela (south to Roraima and Auyan-tepui); casual in Baja California (Miraflores).

Setophaga ruticilla tricolora (Müller): Northern Redstart

Motacilla tricolora Müller, Vollst. Natur.-Syst. Suppl. Reg. Band: 175. 1776. ("Cayenne.")

Females and immature males somewhat darker above, washed with duller green in immature dress; adult males not separable.

Breeds from Yukon, Mackenzie (mouth of Nahanni River, Fort Simpson), and northern Alberta (Athabaska Delta, Fort Chipewyan, Slave River, Moose Factory) south through British Columbia (east of the Coast and Cascade Ranges) to west-central Washington (Winthrop), Idaho, northern Utah, and Montana (Terry, Darnalls, Fort Keogh), eastward through Alberta, Saskatchewan, central Ontario, and Quebec to Newfoundland, northern Maine, New Brunswick, and Nova Scotia (North Sydney, Wolfville).

Recorded in migration and winter in Oregon (McEwen, Ironside), Wyoming (Fort Steele, Douglas), North Dakota (Cannonball, Goodall, Dawson), Nebraska (Valentine), Arizona (Paradise, San Bernardino Ranch), Minnesota (Fort Snelling), Michigan (St. James, Ann Arbor), Illinois (Mount Carmel), Indiana (Wheatland), Arkansas (Winslow), Tennessee (Hornbeak, Crossville), New York (Montauk Light, Shelter Island, Jamaica, Parkville, Cold Spring), New Jersey (Franklin, West Orange, Morristown), Maryland (Chesapeake Beach, Laurel, Kensington), District of Columbia, Virginia (Four Mile Run, Ballston, Falls Church, Campbell County), North Carolina (Reidsville, Pisgah National Forest, Mount Mitchell), Georgia (Stone Mountain Athens, Decatur, Lawrenceville), Texas, (San Antonio, Point Bolivar, Point Isabel, Brownsville), Louisiana (Baton Rouge, Woolmarket, New Orleans), Mississippi (Gulfport, Deer Island, Ship Island), Alabama (Teasley's Mill), Florida (Amelia Island, Gainesville, Dry Tortugas), Veracruz (Tres Zapotes), Yucatán, (Gaumer specimen, probably from Mérida), Puebla (Metlaltoyuca), Tabasco (Teapa); British Honduras (El Cayo, Belize); Guatemala (La Libertad, Petén, Livingston, Progreso, Finca Chama, Secanquim); Honduras (San Pedro Sula), Costa Rica (Volcán Turrialba, Angostura); Panamá (Boqueté); Bahama Islands (Green Cay); Cuba (Mariel, Guamá, Doce Leguas, Puerto Gibara); Swan Island; Jamaica (Salt Ponds, Falmouth); Haiti (St. Michel, Cerca-La-Source, Morne La Hotte, Gonave Island, Île à Vache); Dominican Republic (Moca, Espaillet, Los Cabuyos, Constanza, Ciudad Trujillo, Sánchez); Puerto Rico (Mayagüez, Caguas, Fajardo); St. Thomas; Tortola; Antigua; Dominica; Guadeloupe; Colombia (Bonda, Las Nubes, Onaca, Valparaiso, Cali, Virolín, Maicao); Ecuador (Papallacta); Venezuela (Escorial, Nevado, El Valle, Colonia Továr, Mount Guacharo, Caicara, Mount Auyan-tepui, Cerro Yapacana); Brazil (Serra Imeri, near Salto do Hua).

The two forms apparently migrate and winter together. In the United States in migration they cover the region east of the Rocky Mountains, with occasional stragglers at more western localities. The flight extends through both Central America and the West Indies to northern South America, where the birds are most common in hilly and mountainous areas. While the two range together the northern race is evidently less numerous in individuals, a fact explained by the much smaller breeding area that it occupies.

The specimen reported from Serra Imeri, Brazil, taken December 7, 1930, by E. G. Holt, while on an expedition for the National Geographic Society is one of three records of the redstart from that country. The others are based on a bird taken January 24, 1939, on the upper Rio Cotinga, and on one from the mountain range called Serra Tapirapec or Curupira in April 1946. These two, recorded by Phelps and Phelps,[5] have not yet been identified to subspecies.

[5] Bol. Soc. Ven. Cienc. Nat. 11: 71. 1947.

ICHTHYOLOGY.—*A new species of goby and new records of fishes from the Solomon Islands.*[1] ROBERT R. HARRY, Natural History Museum, Stanford University. (Communicated by Herbert Friedmann.)

During a period from the early summer of 1944 to the late spring of 1945 Robert C. Pendleton, of Weber College, Ogden, Utah, accumulated a small collection of fishes from the Solomon Islands. At least 40 species were taken southeast of "The Slot" (New Georgia Sound) below Indispensable Strait from the Aggella Group (sometimes Ngella) at Russell (Pavuvu), Gavutu, Tulagi, Florida, and Guadalcanal (Guadalcanar) Islands. Many of the species are new records for the Solomon Islands, and almost all are at least new distributional records within the Solomons. Apparently the few specimens collected from Renard Sound, Banika Island, represent the first fish collection ever recorded from the Russell Group.

Pendleton's collections were taken at seven definite localities: (1) Renard Sound, Banika Island, Russell Group, latitude 9°5′S., longitude 159°13′E. (U. S. Hydrographic Office Chart 5980). (2) Brackish creek near Lengo, approximately 2 miles east of the mouth of the Tenaru River, on the north coast of Guadalcanal Island, latitude 9°25′S., longitude 160°8′30″E. (H. O. Chart 2896). (3) Sea level on mud flats at mouth of Tenaru River near the village of Tenaru, Guadalcanal Island, latitude 9°30′S., longitude 160°6′E. (H. O. Chart 2896). (4) Little Tenaru River, southeast tributary of the Tenaru River, latitude 9°30′S., longitude 160°6′E. (H. O. Chart 2896). (5) Tulagi Harbor between Tulagi Island and Makambo Island, Florida Group, latitude 9°5′S., longitude 160°9′E. (H. O. Chart 2916). (6) Gavutu Bay between Gavutu Island and Hutchison Point, Florida Islands, latitude 9°6′S., longitude 160°11′E. (H. O. Chart 2916). (7) Purvis Bay, mouth of Hutchison Channel, north of Port Purvis, Florida Island, latitude 9°6′20″S., longitude 160°13′30″E. (H. O. Chart 3012).

A new species of goby, or sleeper, is described from material taken in a small creek on Guadalcanal and represents the second known species of *Fcgasa*, a genus previously known only from a single specimen from Tutuila Island, Samoa Islands. In addition to the material reported upon, an apparently very distinct undescribed species of *Doryichthys* collected entering a creek near the ocean 1 mile west of Tenaru River, Guadalcanal Island, May 20, 1944, is not included here. This single specimen obtained has been forwarded to Dr. Earl S. Herald, of the California Academy of Sciences, to be included in his investigations of the family Syngnathidae.

The literature on the fishes of the Solomon Islands is extremely scattered and incomplete. Until very recently[2] no actually intensive collections had been undertaken there; although various British, Australian, and American collectors have obtained many specimens during short stays in the Archipelago. The fish fauna of the Solomons was almost completely unknown previous to Dr. Albert Günther's important contribution (1873) in the fish section of Brenchley's *Cruise of the* Curaçoa *among the South Sea Islands.* Günther compiled a list of 68 species of fishes, including two new species, from three separate Solomons collections received nearly at the same time by the British Museum. No data as to locality within the Solomon Islands were given. Alvin Seale (1906) made extensive collections in the South Pacific for the Bishop Museum about 1903 and obtained a large collection of fishes from Shortland Island in the northern part of the Solomons. Six species were described as new. The most important recent review is the very useful checklist of the fishes of the Solomon Islands by Herre (1931). Many of the specimens upon which Herre based his checklist are at Stanford University and have been compared with the present material.

[1] Received December 3, 1948.

[2] Dr. Wilbert McLeod Chapman, while with the Foreign Economic Administration of the United States Government, amassed excellent large collections of the shore and pelagic fishes of the Solomon Islands. At present this material is partly at the School of Fisheries, University of Washington, and partly at the United States National Museum.

Subsequent to Herre, the Templeton Crocker Expedition to western Polynesian and Melanesian Islands, 1933, returned with excellent collections from throughout the Solomons. Seale (1935) reported upon this material, which is presently in the fish collection of the California Academy of Sciences.

The Pendleton collection, including the types, has been deposited in the Natural History Museum of Stanford University, and the number before each locality represents the Stanford catalog number. A set of duplicate specimens has been retained by the collector.

I wish to thank Mr. Pendleton for allowing me to prepare this report upon his interesting collections of fishes and for considerable help throughout. He prepared extensive ecological notes of several of the species and intends to have these observations published.

SYNODIDAE

(1) **Saurida undosquamis** (Richardson)

No. 14761, Purvis Bay, Florida Island, January 22, 1945, 1 specimen.

The range of this species is from East Africa through the Indian Ocean to Australia and Japan. Exact records of its distribution are somewhat confused, because this form has been confounded with the so-called *Saurida tumbil* (Bloch). Apparently it has not been recorded in the Solomons. The nearest previous record is in the Louisiade Archipelago.

ANGUILLIDAE

(2) **Anguilla bicolor** McClelland

No. 14758, Brackish creek near Lengo, Guadalcanal Island, May 20, 1944, 1 specimen.

This species is known throughout the East Indian Archipelago. Its range is here extended eastward from New Britain and numerous localities in northern New Guinea.

MURAENIDAE

(3) **Muraena undulata** (Lacepède)

No. 14760, Purvis Bay, Florida Island, December 23, 1944, 1 specimen.

This species is distributed from the east coast of Africa through the Indian Ocean eastward to Australia and as far as the Hawaiian Islands. Seale (1935, p. 343) records it from the Solomons at Sikaiana Island, Stewart Islands.

(4) **Echidna nebulosa** (Ahl)

No. 14759, Purvis Bay, Florida Island, December 23, 1944, 1 specimen.

East coast of Africa to Australia, Pacific islands. Recorded from Tulagi Island, Florida Islands by Seale (1935, p. 343).

SYNGNATHIDAE

(5) **Hippocampus kuda** Bleeker

No. 14762, Purvis Bay, Florida Island, January 23, 1945, 1 specimen.

Distribution from East Africa through the Indo-Australian Archipelago and to Japan. The species has not been recorded before from the Solomon Islands but has been taken from nearby British South New Guinea.

SERRANIDAE

(6) **Epinephelus cyanostigma** (Cuvier and Valenciennes)

No. 14767, Purvis Bay, Florida Island, December 22, 1944, 1 specimen; No. 14768, same locality, April 1, 1945, 1 specimen; No. 14769, same locality, January 21, 1945, and March 29, 1945, 1 specimen.

Range: Indo-Australian Archipelago. Not previously recorded from Solomon Islands.

(7) **Epinephelus urodelus** (Cuvier and Valenciennes)

No. 14772, Purvis Bay, Florida Island, no date, 1 specimen.

Known from Madagascar through Indian Ocean, Indo-Australian Archipelago eastward to Society Islands. Not previously recorded from the Solomon Islands.

(8) **Epinephelus pachycentron** (Cuvier and Valenciennes)

No. 14771, Purvis Bay, Florida Island, December 16, 1944, 1 specimen.

Previously recorded in the Solomons from Tulagi Island, Florida Group by Seale (1935, p. 359).

(9) **Epinephelus diacanthus** (Cuvier and Valenciennes)

No. 14770, Purvis Bay, Florida Island, December 20, 1944, 1 specimen.

Distributed from East Africa through Indian Ocean to eastern Pacific. Apparently this record represents a range extension eastward from the Philippines.

PSEUDOCHROMIDAE

(10) **Pseudochromis fuscus** Müller and Troschel

No. 14799, Purvis Bay, Florida Island, December 23, 1944, 4 specimens; No. 14800, same locality, January 21 and March 29, 1945, 2 specimens.

Recorded by Herre (1931, p. 6) from Shortland Island, Solomons.

CARANGIDAE

(11) **Caranx crumenophthalmus** Bloch

No. 14765, Purvis Bay, Florida Island, January 20, 1945, 1 specimen.

Apparently this is the first definite locality record within the Solomon Archipelago.

(12) **Caranx chrysophrys** Cuvier and Valenciennes

No. 14764, Purvis Bay, Florida Island, February 5, 1945, 1 specimen.

Distribution from east Africa through Indian Ocean to Australia. Apparently closest record to Solomons is Queensland.

(13) **Decapterus macrosoma** Bleeker

No. 14766, Renard Sound, Banika Island, Russell Group, March 15, 1945, 1 specimen.

Range: East Africa to Australia. Not previously mentioned from Solomon Archipelago.

LUTIANIDAE

(14) **Lutianus vitta** (Quoy and Gaimard)

No. 14775, Purvis Bay, Florida Island, March 25, 1945, 1 specimen.

Range: Seychelles Islands through Indian Ocean to Australia. Previously not known from Solomons. Closest records New Guinea and Louisiade Archipelago.

(15) **Lutianus sebae** (Cuvier and Valenciennes)

No. 14774, Purvis Bay, Florida Island, March 29, 1945, 1 specimen.

East coast of Africa through Indian Ocean, Indo-Australian Archipelago to Australia. Not recorded from Solomons.

(16) **Pentapodus setosus** Cuvier and Valenciennes

No. 14776, Purvis Bay, Florida Island, March 22, 1945, 1 specimen.

Range: Indo-Australian Archipelago. Previously unrecorded in Solomons.

(17) **Monotaxis grandoculis** (Forskål)

No. 14777, Purvis Bay, Florida Island, May 18, 1945, 1 specimen.

Herre (1931, p. 7) established this species in the Solomons from Tenibuli, Ysabel Island; Hathorn Sound, New Georgia Island; Shortland Island; Sikaiana Island; Stewart Island.

MULLIDAE

(18) **Upeneus vittatus** (Forskål)

No. 14763, Purvis Bay, Florida Island, May 18, 1945, 1 specimen.

Very common in Indo-Australian Archipelago. Apparently never reported from the Solomon Islands.

KYPHOSIDAE

(19) **Kyphosus cinerascens** (Forskål)

No. 14778, Gavutu Island, Florida Group May 18, 1945, 1 specimen.

Mentioned by Herre (1931, p. 7) from Solomons at Tenibuli, Ysabel Island; and Shortland Island.

CHAETODONTIDAE

(20) **Chaetodon octofasciatus** Bloch

No. 14787, Purvis Bay, Florida Island, January 21, 1945 and March 29, 1945, 1 specimen.

Ranges through Indo-Australian Archipelago. Recorded by Herre (1931, p. 7) from Solomons at Tenibuli, Ysabel Island, and Bougainville Island. Weber and de Beaufort (1936, p. 75) establish it from New Pommern, Solomons.

POMACENTRIDAE

(21) **Pomacentrus tripunctatus** Cuvier and Valenciennes

No. 14782, Purvis Bay, Florida Island, December 23, 1944, 1 specimen; No. 14783, Purvis Bay, Florida Island, January 21, 1945, and March 29, 1945, 2 specimens.

Recorded from the Solomons by Herre (1931, p. 8) from Auki, Malaita Island; Hathorn Sound, New Georgia Island; Tenibuli, Ysabel Island.

(22) **Pomacentrus bifasciatus** Bleeker

No. 14781, Purvis Bay, Florida Island, December 23, 1944, 3 specimens.

Range: Indian Ocean and Archipelago. Previously unrecorded from Solomons. Closest published accounts at Palau (Pelew) Islands,

Boston Island (Ebon Atoll) and Duke of York Island.

(23) **Dascyllus aruanus** Linnaeus

No. 14779, Purvis Bay, Florida Island, January 21, 1945, and March 29, 1945, 4 specimens.

Previously recorded by Herre (1931, p. 8) from the Solomons at Shortland Island; Kungava Bay, Rennell Island; Sikaiana Island, Stewart Islands.

(24) **Dascyllus melanurus** Bleeker

No. 14780, Purvis Bay, Florida Island, January 21, 1945, and March 29, 1945, 1 specimen.

Previously recorded from the Solomons by Herre (1931, p. 8) at Shortland Island and by Seale (1935, p. 368) at Kungava Bay, Rennell Island; Sikaiana Island, Stewart Islands.

(25) **Premnas biaculeatus** (Bloch)

No. 14784, Purvis Bay, Florida Island, January 21, 1945, and March 29, 1945, 1 specimen.

Previously recorded from Kungava Bay, Rennell Island, Solomons by Seale (1935, p. 365).

LABRIDAE

(26) **Cheilinus fasciatus** (Bloch)

No. 14785, Purvis Bay, Florida Island, December 28, 1944, 1 specimen.

Previously reported from the Solomons by Herre (1931, p. 8) at Tenibuli, Ysabel Island; Shortland Island.

(27) **Thalassoma lunare** (Linnaeus)

No. 14786, Purvis Bay, Florida Island, January 16, 1945, 1 specimen.

Previously recorded from the Solomons by Herre (1931, p. 8) at Hathorn Sound, New Georgia Island, and Shortland Island.

TEUTHIDIDAE

(28) **Zebrasoma flavescens** (Bennett)

No. 14788, Renard Sound, Banika Island, Russell Group, April 14, 1945, 1 specimen.

Previously recorded from Hathorn Sound, New Georgia Island, Solomons, by Herre (1931, p. 7).

ELEOTRIDAE

(29) **Eleotris melanosoma** Bleeker

No. 14795, Little Tenaru River, Guadalcanal Island, May 14, 1944 (fresh water), 1 specimen.

Reported by Herre (1931, p. 9) from Auki, Malaita Island, Solomons, in fresh water.

(30) **Fagasa diaphana**, n. sp.

This species is very closely related to *Fagasa tutuilae* Schultz (1943, p. 253) and represents the second known species of this remarkable genus. Schultz described *F. tutuilae* from a single young specimen 18.5 mm in standard length. Though he distinguished this genus from all other groups of the family Eleotridae, he made no mention of its relationships and position in the family. One of the most striking characteristics of *F. tutuilae* is its emarginate caudal (shown as lunate in the figure), which apparently is present in only one other eleotrid genus, *Ptereleotris*. All other eleotrids have rounded or elongated caudals. *Ptereleotris*, however, has much higher counts for soft dorsal rays (24–32 versus 6–8), anal soft rays (22–27 versus 8), and longitudinal scale series (150–170 versus 19–31). It is expected that future collections near the mouths of shallow coastal streams in the Pacific oceanic islands will reveal additional representatives of this group.

Holotype.—Stanford University No. 14894; 17.3 mm in standard length; mouth of small brackish stream near Lengo, north coast of Guadalcanal Island, May 20, 1944.

Paratypes.—Stanford University no. 14895; 6.8–18.3 mm in standard length; same data as holotype; 70 specimens. Stanford University number 14896; 15.8–18.4 mm in standard length; entering creek, one mile west of Tenaru River (from salt water), Guadalcanal Island, May 20, 1944; 3 specimens.

Diagnosis.—This species is referable to the genus *Fagasa* on the basis of the following characters: Mouth nearly vertical; no teeth on vomer; gill membranes continued moderately far forward and joined to the isthmus without a free fold across it; body anteriorly naked; the scales ctenoid, beginning under the second dorsal; dorsal fin rays VI, I, 8; anal fin I, 8; pectoral fin 17 or 18; pelvic fins completely separate without connecting basal membrane; all fin rays simple, unbranched; caudal fin emarginate or lunate.

This species can be readily differentiated from the only other known species, *F. tutuilae*. The lower jaw in *diaphana* is prominent, definitely entering into the dorsal profile, while in *tutuilae*

the lower jaw is not so well developed and does not enter the dorsal profile. Scales 19–21 in a midlateral series to caudal base in the latter, 31 in the former. The scales in the new species are confined to an oval patch on the sides of the body 6 or 7 scales in height; no scales extend onto the caudal fin. The figure of *tutuilae* shows the scales apparently continuous on each side of the body dorsally behind the dorsal fin and ventrally behind the anal fin; there appear to be at least 10 oblique scale rows; in addition the base of the caudal fin is illustrated as scaled. None of these scale characters are discussed by Schultz, however. The pelvic fins in *diaphana* extend only slightly beyond a vertical from the origin of the first dorsal fin, but in the figure of *tutuilae* the pelvics extend beyond the first dorsal fin base.

Description.—Measurements were made with fine-pointed dividers and divided into either head or standard length as indicated. Considering the very small size of the types, there is an unavoidably significant margin of error in measurement, and only the measurements for the holotype are presented. More importance has been placed in the description of species characteristics. Counts were taken from 25 specimens. The results for the paratypes are placed in parentheses and are preceded by those for the holotype.

Body elongate, moderately compressed, greatest depth between tips of pelvic fins and anus, 6.4 in standard length.

Head elongate, somewhat depressed, its length 3.6 in standard length. Profile almost straight between snout and interorbital; slightly raised before vertical from eye. Snout length 4.5 in head. Anterior nostril at border of labial fold, on a level with middle of eye. Posterior nostril at upper anterior border of eye. Both nostrils lack raised borders except anterior margin of posterior nostril with a slightly raised flap. Orbit large, posterior margin nearer to snout tip than opercular margin, diameter 5.0 in head length. Interorbital much narrower than eye diameter, 8.3 in head. Jaws strongly oblique, the lower jaw prominent, definitely entering into the dorsal profile. Maxillary extends distinctly lower than eye in horizontal level, but does not reach a vertical from anterior margin of eye. Length of upper jaw 3.3 in head. Jaws with a single row of moderate canines laterally, two or three closely spaced rows anteriorly. No teeth evident on vomer or palatines.

The pattern of head papillae distinctly the same as that characteristic of the subfamily Eleotrinae (see Harry, 1948, pp. 14–15, figs. 1, 2). No pores are present except one, usually denoted in the literature as pore a, that is situated at the upper posterior border of the eye. No papillary grooves are present. Generally five single papillae lines radiate from the ventral border of eye. Papillae lines on sides of head prominent, in single series. Interorbital naked, lacking papillae, except for three short parallel rows radiating inward from eye (genipore rows *t*, *v*, and *w*); *b* and *d* series on cheek well developed; *c* series very short, confined to above end of maxillary; *a* series irregular, interrupted and indistinct; *os*, *ot*, and *or* series on operculum well developed and elongate. A single continuous row of papillae designated by Ilgin and de Buen as *n* extends completely across the nape.

Scales ctenoid with large ctenii, confined to posterior half of body in an oval-shaped area on each side. Scales begin above origin to end of anal base and extend almost to base of caudal fin. Nineteen to 21 scales from where they begin along midaxis of body to base of caudal fin. Six or seven vertical oblique series of scales.

First dorsal fin rounded, with six rays. Outline not as in figure of *tutuilae*. First rays graduated, third ray longest. Last spinous dorsal ray very short, bound to back. Length of first dorsal base 7.3 in standard length. Origin of first dorsal over tips of pelvic rays, its distance from tip of snout 2.3 in standard length. Second dorsal outline as in figure of *tutuilae*, except penultimate and last rays shorter, the outline more abruptly rounded. Length of second dorsal base 7.9 in standard length. Origin of second dorsal slightly in advance of anal origin. Anal rays I, 8, outline of fin the same as in *tutuilae*. Length of anal base 7.9 in standard length. Distance from tip of snout to anal origin 1.7 in standard length.

Pectoral large and rounded with 17 or 18 rays, extending to a vertical from the end of the base of the first dorsal. Length of longest pectoral ray 4.8 in head length. Pelvic fins I, 5, separated to the base and without a basal membrane. Pelvic origin slightly behind pectoral origin, its rays extending slightly beyond a vertical from first dorsal origin. Outline of pelvic fins similar to that of *tutuilae*.

Caudal fin large; lunate or emarginate. No scales on base of fin. Principal caudal rays 12

or 13, none divided. Length of caudal fin 3.8 in standard length.

Measurements in percentage of standard length: Body depth 15.6; caudal peduncle least depth 12.3; length of caudal peduncle from base of last dorsal ray to midbase of caudal fin 26.5; head length 28.9; snout length 6.4; upper jaw length 8.7; orbit length 5.8; interorbital width 3.5; distance from tip of snout to spinous dorsal origin 41.6; spinous dorsal base length 13.9; longest dorsal spine length 15.3; soft dorsal base length 12.7; distance from tip of snout to anal origin 58.3; anal base length 12.7; longest anal soft ray length 14.4; pectoral fin base width 5.8; pectoral fin length 20.8; distance from tip of snout to pelvic fin origin 30.0; pelvic fin length 16.8; caudal fin length from midbase to tip of longest lateral ray 26.0.

Coloration.—Mr. Pendleton has informed me that all the specimens were "virtually transparent" when alive. In alcohol (first preserved in formaldehyde) they are an opaque flesh color with large scattered chromatophores arranged in a definite characteristic pattern. Body with a few scattered melanophores on upper sides of body, on the base of the pectoral fin and a single series along each side of the bases of the dorsal fins. A darker, more deeply imbedded interrupted pigment streak extends along the midventral line of the body from a vertical immediately behind the eye to the procurrent caudal rays. A longitudinal blotch is present on the median section of chin. The most striking color feature is a rectangular blotch of melanophores at the base of the caudal fin. Widely spaced scattered melanophores present behind eye and on top of head, somewhat concentrated on occiput.

This species is named *diaphana* from the Greek *diaphanes* = transparent in reference to the transparency of the living examples.

GOBIIDAE

(31) **Gobiodon erythrospilus** Bleeker

No. 14899, Purvis Bay, Florida Island, December 23, 1944, 1 specimen.

It has not been recorded from the Solomons in the literature.

(32) **Gobiodon quinquestrigatus** Cuvier and Valenciennes

No. 14796, Purvis Bay, Florida Island, December 23, 1944, 14 specimens; no. 14797, Purvis Bay, Florida Island, January 21, 1945, or March 29, 1945, 1 specimen.

A large number of forms, probably several distinct species are recognized under this species. The genus *Gobiodon* is in great need of revision.

Previously recorded under the name *Gobiodon rivulatas* from Kungava Bay, Rennell Island by Seale (1935, p. 372 and from Howla Island, Solomons, by Herre (1931, p. 9).

(33) **Paragobiodon echinocephalus** (Rüppell)

No. 14798, Purvis Bay, Florida Island, December 23, 1944, 21 specimens.

Previously recorded from Bougainville Island and Shortland Island, Solomons, by Herre (1935, p. 9).

PERIOPHTHALMIDAE

(34) **Periophthalmus koelreuteri** (Pallas)

No. 14897, mouth of small brackish stream near Lengo, north coast of Guadalcanal Island, May 20, 1944, 8 specimens; no. 14898, sea level on mud flats at mouth of Tenaru River, Guadalcanal Island, May 20, 1944, 2 specimens.

Previously recorded from Auki, Malaita Island and Bougainville Island, Solomons, by Herre (1931, p. 9).

BLENNIIDAE

(35) **Salarias guttatus** Cuvier and Valenciennes

No. 14801, Purvis Bay, Florida Island, January 4, 1945, 2 specimens.

Apparently not known from Solomons. Dr. W. M. Chapman made this determination for me.

TRIGLIDAE

(36) **Abalistes stellaris** (Bloch and Schneider)

No. 14789, Purvis Bay, Florida Island, December 28, 1944, 1 specimen.

Previously unrecorded from the Solomons.

(37) **Balistapus capistratus** (Tilesius)

No. 14790, Purvis Bay, Florida Island, December 23, 1944, 1 specimen; no. 14791, same locality, January 15, 1945, 1 specimen; no. 14792, same locality, March 15, 1945, 1 specimen.

Previously unrecorded from the Solomons.

(38) **Odonus niger** (Rüppell)

No. 14793, Gavutu Bay, Gavutu Island, Florida Group, May 8, 1945, 1 specimen.

Apparently the first definite locality record for the Solomons.

(39) **Tetraodon nigropunctatus** Bloch and Schneider

No. 14794, Tulagi Harbor, Tulagi Island, Florida Group, May 1, 1945, 1 specimen.

Recorded from Shortland Island, Solomons, by Herre (1931, p. 9).

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Obituaries

FRANÇOIS EMILE MATTHES.—In 1947, after 51 years of distinguished service with the U. S. Geological Survey, François Emile Matthes retired to El Cerrito, Calif. There, near the mountains he loved, he planned to continue the studies to which he had devoted much of his long and fruitful life. These plans, however, were abruptly ended by his death on June 21, 1948, less than a year after his retirement.

Although born in Amsterdam, Holland, on March 16, 1874, he came with his family to America in 1891 and soon became a naturalized citizen. In 1895 he received a B.S. degree from the Massachusetts Institute of Technology and the following year joined the Topographic Branch of the Geological Survey. For almost 20 years he was engaged in the preparation of topographic maps of such spectacular and difficult areas as the Big Horn Mountains, that part of the Rocky Mountains which is now Glacier National Park, the Grand Canyon of the Colorado, Yosemite Valley, and Mount Rainier National Park. The superb artistry and deep understanding of landforms, displayed in his delineation of terrain by the contour line, were matched by his interest in the processes which produced these landforms. His early work in the Big Horn Mountains led directly to studies of glaciation and the geomorphic processes of high altitudes, reported in the first of his long series of publications, *The glacial sculpture of the Big Horn Mountains* (21st Ann. Rep. U. S. Geol. Surv., pt. 2. 1900), in which he named the process of "nivation." In 1914, Mr. Matthes transferred to the Geologic Branch of the Geological Survey in order to devote himself exclusively to studies of glaciers and the development of landforms. However, during both World Wars I and II he was called by the Army and Air Forces to be a consultant. His long record of professional achievements are typified by his classic study, *The geologic history of the Yosemite Valley* (U. S. Geol. Surv. Prof. Pap. 160. 1930).

In 1931 Mr. Matthes was made chairman of the committee on glaciers of the section of hydrology of the American Geophysical Union, charged with collecting the results of studies and measurements of existing glaciers and their fluctuations throughout the world. At the time of his death he was also secretary of the commission on snow and glaciers of the International Association of Scientific Hydrology of the International Union of Geodesy and Geophysics. His interest in glaciers and the processes of glaciation, and his recognition of the recent reestablishment of glaciers in the mountains of western United States, named by him the *Little Ice Age* (chapter on "Glaciers" in *Hydrology*, Physics of the Earth Series **9**: 1942), led directly into the disciplines of climatology and meteorology. At the time of his death he was engaged in the completion of an important critical analysis of the glacial anticyclone theory, of which only part 1 has been published, *The glacial anticyclone theory in the light of recent meteorological data from Greenland* (Trans. Amer. Geophys Union **27**: 324–341. 1946).

In recognition of Mr. Matthes' high professional attainments, he was decorated Chevalier, Order of Leopold II (Belgium) in 1920, elected president of the Geological Society of Washington in 1932, president of the American Association of Geographers in 1933, and vice-president of the Washington Academy of Sciences from the Geological Society of Washington in 1934. Shortly before his death he was presented a gold medal by the Department of the Interior for his long and distinguished service to the Government. When, in 1947, he received an honorary LL.D. degree from the University of California, President Sproule said, "By your artistry in the delineation of landforms and your clear, scientific description, you have interpreted the beauty of the western American landscape to the mind, as well as the eyes, of all who love the mountains." Through active association with such organizations as the National Park Service, the Boy Scouts of America, and the Sierra Club, and through the many popular scientific articles written for the layman, he brought his appreciation and understanding of the beauty and development of the landscape to the layman. The honor which he prized most highly was the "Order of the Silver Beaver," conferred upon him by the Council of the Boy Scouts of America for "distinguished service to boyhood."

The passing of François Emile Matthes is a great loss to his many professional and personal friends throughout the world. He leaves to us as an enduring monument, his published works in which we can find his deep understanding, appreciation, and devotion to the beauty and orderliness of the natural landscape.

LOUIS L. RAY.

OSCAR EDWARD MEINZER was born on a farm near Davis, Ill., on November 28, 1876. He died in his home in Washington, D. C., on June 14, 1948. He is survived by his wife, Alice Crawford Meinzer, and two sons—Robert William, of Berwyn Heights, Md., and Roy Crawford, of New Brunswick, N. J.

Meinzer was one of six children of William and Mary Julia Meinzer. From them he acquired a strong hatred of war, deep religious convictions, an independent inquiring but orderly mind, and a capacity for hard, concentrated work. His interest in geology was aroused during his early boyhood by his observation of fossil-packed limestone beds overlain by glacial till containing erratics that were foreign to the locale of his father's farm. His interest in ground water was aroused at an early age by the difficulties experienced by his father in obtaining water for domestic and stock use. As a means to knowledge about these and many other observations that aroused his curiosity, he eagerly seized the opportunity for a college education and entered Beloit College (Wisconsin) from which he was graduated, magna cum laude, in 1901, having been elected to Phi Beta Kappa. After graduation he was principal of schools at Frankfort, S. Dak., for two years. He then taught science at Lenox College, Iowa, and in 1905 entered the graduate school at the University of Chicago, which later awarded him the degree doctor of philosophy, magna cum laude.

Having completed his residence requirements at Chicago, in 1907 he was appointed junior geologist in the U. S. Geological Survey and began his lifelong study of ground water. In 1913 he was made chief of the Ground Water Division, and he continued in that capacity until his retirement on November 30, 1946.

Meinzer made many investigations of the geology and ground-water resources of various areas in the West, in Cuba, and in the Hawaiian Islands. In later years he wrote extensively on the occurrence of ground water, its recharge, movement, and discharge. His bibliography contains about 110 items, most of which are substantial contributions to science. The most important of these probably are his *Occurrence of ground water in the United States, with a discussion of principles*, *Outline of ground-water hydrology, with definitions*, and the volume on *Hydrology* of which he served as editor and also wrote a section on the occurrence of ground water, and was co-author of a section on the movements of ground water.

Early in his career, Meinzer recognized that ground water was destined to become increasingly important as a natural resource and that adequate methods would have to be worked out for determining the location, distribution, volume, and physical characteristics of ground-water reservoirs; their storage capacities, rates of recharge, movement, and discharge and the safe rates of withdrawals of water from them. Previous work had been along two distinct lines, by the geologists and by the physicists and engi-

neers, with little or no coordination between these groups. One of the greatest services that Meinzer performed was to bring together geologists and engineers in the development of a systematic and comprehensive science of groundwater hydrology.

Dr. Meinzer was president of the Washington Academy of Sciences in 1936; president of the Geological Society of Washington in 1930–31; a charter member of the Society of Economic Geologists and its president in 1946. He took an active part in the formation of the section of hydrology of the American Geophysical Union and was its first chairman. At the time of his death he was president of the American Geophysical Union; president of the International Commission on Subterranean Water, and American member of the executive committee of the International Association of Scientific Hydrology. He was a fellow of the Geological Society of America and of the American Association for the Advancement of Science; a member of the National Research Council; the American Water Works Association; and the Pick and Hammer Club of Washington. He was also a member of Sigma Xi and of the Cosmos Club of Washington.

Dr. Meinzer was awarded the Bowie Medal of the American Geophysical Union in 1943 for outstanding contributions to hydrology, and in 1946 was awarded the honorary degree doctor of sciences by his alma mater, Beloit College.

He was deeply interested in people, especially in boys. For many years he was an elder and taught boys' classes in the Sherwood Presbyterian Church (Washington). He participated actively in the Boy Scout movement, first as a scoutmaster and later as a member of the Capital Area Council. He was a 30-year veteran in the Scouts.

Although he retired from active duty with the Geological Survey in 1946, Meinzer continued active. Until the day of his death he was busily preparing for the Assembly of the International Union of Geodesy and Geophysics in Oslo, which he expected to attend with Mrs. Meinzer, and was engaged in writing a treatise on ground water, which remains unfinished. His death is a great loss to science, to a host of friends and admirers, and to the many colleagues who were initiated in ground-water investigations under his critical but kindly leadership.

A. Nelson Sayre.